State of Connecticut

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Thirty-third and Thirty-fourth Annual Reports

OF

The Connecticut Agricultural Experiment Station

Being the biennial report for the two years ended October 31,

1909-1910

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1910

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

September 30, 1910

BOARD OF CONTROL.

His Excellency, Frank B. Weeks, *ex officio, President.*

Prof. H. W. Conn, *Vice President*..........................Middletown.
William H. Brewer, *Secretary*..........................New Haven.
E. H. Jenkins, *Director and Treasurer*..........................New Haven.
George A. Hopson..........................Wallingford.
C. M. Jarvis..........................Berlin.
Frank H. Stadtmueller..........................Elmwood.
James H. Webb..........................Hamden.

STATION STAFF.

Administration.	E. H. Jenkins, Ph.D., *Director and Treasurer.* Miss V. E. Cole, *Librarian and Stenographer.* Miss L. M. Brautlecht, *Bookkeeper and Stenographer.*
Chemistry.	
Analytical Laboratory.	John Phillips Street, M.S., *Chemist in Charge.* E. Monroe Bailey, Ph.D., C. B. Morrison, B.S., R. B. Roe, A.B., C. E. Shepard, *Assistants.* Hugo Lange, *Laboratory Helper.* V. L. Churchill, *Sampling Agent.*
Proteid Research.	T. B. Osborne, Ph.D., *Chemist in Charge.* Miss E. L. Ferry, A.B., *Assistant.* Miss Luva Francis, *Stenographer.*
Botany.	G. P. Clinton, S.D., *Botanist.* E. M. Stoddard, B.S., *Assistant.* Miss M. H. Jagger, *Seed Analyst.* Miss E. B. Whittlesey, *Herbarium Assistant.*
Entomology.	W. E. Britton, Ph.D., *Entomologist; also State Entomologist.* B. H. Walden, B.Agr., D. J. Caffrey, B.Agr., A. B. Champlain, *Assistants.* Miss E. B. Whittlesey, *Stenographer.*
Forestry.	Samuel N. Spring, M.F., *Forester; also State Forester and State Forest Fire Warden.* W. O. Filley, *Assistant.* Miss E. L. Avery, *Stenographer.*
	H. K. Hayes, B.S., *Plant Breeder.* C. D. Hubbell, *Assistant.*

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Report of the Board of Control

of

The Connecticut Agricultural Experiment Station.

To His Excellency, Frank B. Weeks, Governor of Connecticut:

The Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully submits its report for the two years ending November 1, 1910.

The limit imposed by law on the size of our printed report makes it inadvisable to summarize here the work of the several departments, as has been done in previous years. A detailed account of it will appear in the reports of the members of the Station staff which follow.

We therefore notice only those facts relating to the Station which will not be discussed in the special reports.

The following minute regarding the former director of this Station was adopted by the Board, August 4, 1909:

Professor Samuel W. Johnson, the organizer and for twenty-two years the director of this Station, died at his home in New Haven, July twenty-first, 1909, in his eightieth year.

He entered the Sheffield Scientific School of Yale College as a student and for more than fifty years was a professor in it, sharing in its early struggles and its ultimate success.

His scientific attainments and their public recognition, his service as an educator and his contributions to chemical science may more appropriately be discussed elsewhere. His special work for the advancement of agriculture is all that can be very briefly noted here.

From his youth he devoted his life to the study of chemistry, particularly in its relations to agriculture and to the use of this knowledge in the service of farmers.

He laid well the foundation for the great work he was to do by studying under the masters of the science, Professors John P. Norton and Benjamin Silliman, Jr., at Yale College, and Erdmann, Liebig, Pettenkoffer and von Kobel in Leipsic and Munich.

Thus fully equipped at the beginning, he continued to be a close student of his chosen subject to the end of his life.

His first publications on agricultural subjects were in 1847. Prior to 1853 he began the work of examination of commercial fertiltizers in this State and continued it almost without intermission until it was taken up by the Agricultural Station in 1875.

The early published reports of The Connecticut Agricultural Society and of The Connecticut Board of Agriculture, enriched by his reports, lectures and essays, became classic as an encyclopedia of agricultural science at a time when that science was young and almost unknown to the public. They also showed to Connecticut farmers that the investigator and chemist were of practical help to them and so prepared the way for the reception of the idea of an institution entirely devoted to scientific work in the interest of the farmer.

In 1868 he published How Crops Grow, a book which has been more widely read and studied than any other work on agricultural chemistry which was ever issued. It was reprinted in England, translated into the German, Russian, Swedish, Italian and Japanese languages and used as a text-book in those tongues.

In 1870 he published How Crops Feed, which was similarly translated and used.

These two books presented in small compass and with unsurpassed clearness and conciseness the present state of knowledge of agricultural science. As their author said, "His office has been to digest the cumbrous mass of evidence in which the truths of vegetable nutrition lie buried out of the reach of the ordinary inquirer, and to set them forth in proper order and in plain dress for their legitimate and sober uses."

His greatest achievement for agricultural science and for the farmers of the whole country was in so clearly showing, by his own work of more than twenty years in laboratory and study and on the platform, what an Agricultural Station could do for the help of practical agriculture, as to convince the farmers and lawmakers of this State of the wisdom of establishing such an institution for the first time on this continent.

Thus he secured for Connecticut, with the aid of others who were taught by him, the honor of inaugurating in this country the work of Agricultural Experiment Stations which are now in successful operation in every State in the Union.

Professor Johnson was first of all an earnest student, and a clear thinker. He also had the rare gift of expressing himself in clear, concise, logical English and of discussing scientific facts and theories judicially and accurately and at the same time so simply and effectively as to put them within the understanding of those who had no previous acquaintance with such matters.

As a teacher of agricultural teachers, as a leader in agricultural science, and as the father of the movement to bring to the farmer all the help which the sciences can furnish by means of the Agricultural Stations, he has left a name to be remembered with great honor.

The Members of the Board of Control of this Station, which is one of the monuments of his life work and which so long enjoyed his direction and counsel, desire to record by this minute their appreciation of his great services to the farmers of this State and to American agriculture.

In the hall of the new building, to which reference is made later, friends of Professor Johnson have placed a bronze tablet with this inscription:

IN MEMORY OF
SAMUEL WILLIAM JOHNSON,
WHO FOR MORE THAN FIFTY YEARS SERVED THE
AGRICULTURE OF THIS STATE AND NATION AS
A TEACHER, AUTHOR AND INVESTIGATOR.
LARGELY THROUGH HIS LABORS THE FIRST
AGRICULTURAL EXPERIMENT STATION
IN THE UNITED STATES WAS
ESTABLISHED IN CONNECTICUT.
DIRECTOR OF THIS STATION FROM 1877 TO 1900.

The following changes in the Station officers and staff have occurred:

George A. Hopson of Wallingford succeeded B. W. Collins of Meriden as a member of the Board of Control, July 1, 1909.

Messrs. C. A. Brautlecht and Clarence Rodman, chemists, resigned in 1909 and were succeeded by Messrs. R. B. Roe, B.A., and C. E. Shepard.

Austin F. Hawes, M.F., State and Station forester, resigned in April, 1909, to become State and Station forester in Vermont. Mr. W. O. Filley served acceptably as acting forester until October 1, 1909, when Samuel N. Spring, B.A., M.F., was appointed forester.

E. M. East, Ph.D., who was for four years our agronomist, resigned September 1, 1909, to accept a professorship in Harvard University. Dr. East has been able, through the courtesy of the University, to retain a general direction of the plant breeding work of the Station, which he inaugurated, and Mr. H. K. Hayes, a graduate of Amherst Agricultural College, has carried on the field and laboratory work as a member of the staff of this Station.

Dr. Clinton, Station botanist, was given two months' leave of absence, being commissioned by Harvard University to visit Japan and to find and bring back alive, if possible, a fungus which is there parasitic on the gypsy moth and which may be

useful in fighting the same insect here. This somewhat difficult work he did successfully.

Mr. Paul Graff acted as botanical assistant in the summer of 1909, and Mr. E. M. Stoddard, a graduate of the Connecticut Agricultural College, was made permanent botanical assistant in December, 1909.

Mr. James B. Olcott, for many years in charge of the Station grass garden, to which he was passionately devoted and in which he had gathered the best turf grasses from all quarters of the globe, died on April 23, 1910.

The General Assembly in 1909 appropriated $30,000 to build a fireproof addition to our chemical laboratory. This was begun in October, 1909, and was ready to be roofed in when, on the morning of January 10, 1910, a fire, believed to be of incendiary origin, burned out the building to which the new structure was an addition. Little harm was done to the new construction. The walls of the burned building were not badly damaged, but immediate action was necessary to protect them. The Board, therefore, ordered the rebuilding, with construction uniform with the addition, making of the whole a symmetrical fireproof building. The walls are of brick, floors and roof of reinforced concrete, stairways of steel or concrete, and partitions of steel studding and metal lath. The addition was built for the sum appropriated, $30,000.

From insurance, sales of junk, etc., the Station received $11,064.40, applicable to rebuilding. To complete and equip the rebuilt laboratory has required about $6,500 additional, which the Board has borrowed, believing that the next General Assembly will make an appropriation to cover this amount. The fact that without this building the Station could not do the work required of it in the time which must necessarily elapse before the legislature could take action, in the opinion of the Board, fully justified its action.

Besides the building, the fire destroyed much valuable material, books, apparatus, etc., and has very seriously hindered the regular work of the Station.

Now, for the first time in its history, the valuable collections, scientific apparatus and a portion of the library of the Station are properly protected from loss by fire and are insured to their full value.

In 1910 the Station made a rather full exhibit at five of the Agricultural Society fairs in the State, each of which was open for at least three days. This exhibit is purely educational, setting forth the work of the several departments of the Station and some of the results. Members of the staff were present as far as was possible to explain the work and answer questions. Large numbers visited the exhibit and studied what was shown. It amounted to five weeks of continuous Institute work and, while it greatly interrupted our field and laboratory work, it was quite worth while because it showed to a very large number of farmers of the State what the Station stood for, how it helped and could help them, and established personal relations with the Station staff.

Another very useful adjunct to the Station work has been the experiment field in Centerville, not far from the Station office and laboratories. Here have been conducted the experimental breeding work with corn and tobacco, the testing of lime-sulphur summer sprays on fruit trees, the handling of a neglected orchard, and the growing of a number of field crops—alfalfa, red clover, crimson clover, cowpeas, soy beans and winter vetch.

On August 10, 1910, a field meeting was held at the Station, to informally dedicate the new laboratory building, at which more than four hundred farmers and their wives were present. In the afternoon this company went from the Station to the field and inspected and informally discussed the work there. It is intended to hold this summer field meeting each year.

The field meeting and the fair exhibits have certainly proved themselves to be most interesting and helpful both to the Station and to the farmers of the State. In a state of the size of Connecticut and with our system of steam and trolley roads, we believe that the fair exhibits may be made more effective as a means of agricultural education than the "agricultural education trains," which have been effective in less populous and more widely scattered agricultural communities.

In the two years there have been printed parts of two biennial reports, aggregating eight hundred and fifty-five pages, with fifty plates, in editions of ten thousand copies; five bulletins aggregating one hundred and twenty-one pages, with nine-

teen figures and plates, in editions of nine thousand three hundred; and ten leaflets on farm matters, to be enclosed in letters.

Within the same time more than sixteen thousand letters and manuscript reports have been written and mailed from the Station.

Members of the staff have made addresses or read papers at eighty-seven farm institutes or meetings of farmers' organizations.

All of which is respectfully submitted.

(Signed) GEORGE A. HOPSON, *Secretary.*

NEW HAVEN, CONN., November 1, 1910.

REPORT OF THE TREASURER, 1909

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1909.

Receipts.

Balance on hand, October 1, 1908 (Analysis Fees) ...		$863.40
State Appropriation, Agriculture	$10,000.00	
State Appropriation, Food	2,500.00	
State Appropriation, Insect Pest	3,000.00	
State Appropriation, Gypsy Moth	1,500.00	
United States Appropriation, Hatch	7,500.00	
United States Appropriation, Adams	5,750.00	
Analysis Fees	7,470.02	
Sale of Farm Products	169.13	
Miscellaneous Receipts	736.32	
From the Lockwood Estate	8,065.88	
		46,691.35
Total		$47,554.75

Disbursements.

E. H. Jenkins, salary	$2,800.00
W. H. Brewer, "	100.00
V. E. Cole, "	850.00
L. M. Brautlecht, "	666.67
J. P. Street, "	2,500.00
T. B. Osborne, "	2,333.33
E. M. Bailey, "	1,550.00
C. B. Morrison, "	1,018.33
C. A. Brautlecht, "	960.00
R. B. Roe, "	370.37
C. W. Rodman, "	539.98
W. E. Britton, "	2,000.00
G. P. Clinton, "	1,833.32
A. F. Hawes, "	900.00
W. O. Filley, "	412.90
E. M. East, "	1,966.66
H. K. Hayes, "	250.00
C. S. Leavenworth, "	100.00
J. B. Olcott, "	200.00
H. Lange, "	925.00
V. L. Churchill, "	825.00
William Veitch, "	[illegible]75.00
Luva Francis, "	583.33
H. W. Kiley (Labor)	728.00

Wm. Pokrob (Labor)	$ 728.00	
C. D. Hubbell "	728.00	
M. Howley "	115.50	
G. Graham "	252.00	
Labor	3,316.43	
Publications	1,522.13	
Postage	335.68	
Stationery	269.28	
Telephone and Telegraph	141.27	
Freight and Express	127.96	
Gas and Kerosene	405.85	
Coal	1,156.25	
Water	127.78	
Chemicals and Laboratory Supplies	1,295.05	
Agricultural and Horticultural Supplies	421.95	
Miscellaneous Supplies	350.41	
Fertilizers	262.09	
Feeding Stuffs	148.61	
Library and Periodicals	1,106.40	
Tools and Machinery	47.56	
Furniture and Fixtures	180.63	
Scientific Apparatus	123.77	
Traveling by the Board	176.40	
Traveling by the Staff	1,091.33	
Traveling in connection with Adams Fund Investigations	282.31	
Fertilizer Sampling	172.25	
Food Sampling	324.39	
Insurance	30.60	
Insect Pest Appropriation to State Entomologist	3,000.00	
Contingent	733.12	
Lockwood Expenses	400.00	
Gypsy Moth Appropriation to State Entomologist	1,500.00	
Betterments	162.21	
Repairs	376.79	
Rental of Land	185.00	
		$46,684.89
State Agricultural Appropriation, on hand, Sept. 30, 1909		869.86
Total		$47,554.75

New Haven, Conn., October 26, 1909.

This Certifies that we have examined the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station for the year ending September 30, 1909, have compared the same with the vouchers therefor, and find them correct.

William P. Bailey,
Edward S. Roberts,
Auditors of Public Accounts.

REPORT OF THE TREASURER, 1910

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1910.

Receipts.

Balance on hand, October 1, 1909 (State Agricultural Appropriation)		$869.86
State Appropriation, Agriculture	$10,000.00	
State Appropriation, Food	2,500.00	
State Appropriation, Insect Pest	3,000.00	
State Appropriation, Gypsy Moth	4,150.00	
United States Appropriation, Hatch	7,500.00	
United States Appropriation, Adams	6,750.00	
Analysis Fees	11,000.00	
Sale of Farm Products	167.81	
Miscellaneous Receipts	283.07	
From the Lockwood Estate	10,501.48	
		55,852.36
Total		$56,722.22

Disbursements.

E. H. Jenkins, director, salary	$2,800.00
E. H. Jenkins, treasurer, "	233.34
W. H. Brewer, salary	100.00
V. E. Cole, "	850.00
L. M. Brautlecht, "	750.00
J. P. Street, "	2,500.00
T. B. Osborne, "	2,400.00
E. M. Bailey, "	1,453.13
C. B. Morrison, "	1,100.00
R. B. Roe, "	1,035.00
C. E. Shepard, "	816.67
W. E. Britton, "	2,000.00
G. P. Clinton, "	2,200.00
E. M. Stoddard, "	554.17
S. N. Spring, "	2,125.00
W. O. Filley, "	521.49
E. M. East, "	333.34
H. K. Hayes, "	1,000.00
C. S. Leavenworth, "	100.00
E. L. Ferry, "	950.82
J. B. Olcott, "	[illegible].67
H. Lange, "	925.00

V. L. Churchill, salary	$ 825.00	
William Veitch, "	675.00	
Luva Francis, "	500.00	
H. W. Kiley (Labor) Sept. 25, 1909, to Oct. 1, 1910	742.00	
Wm. Pokrob " " " " " " " "	742.00	
C. D. Hubbell " " " " " " " "	742.00	
Geo. Graham " " " " " " " "	636.00	
Labor	4,043.83	
Publications	598.46	
Postage	250.51	
Stationery	362.09	
Telephone and Telegraph	139.14	
Freight and Express	255.53	
Gas and Kerosene	438.91	
Coal	1,105.00	
Water	106.86	
Chemicals and Laboratory Supplies	1,147.62	
Agricultural and Horticultural Supplies	253.05	
Miscellaneous Supplies	743.22	
Botanical Supplies	9.93	
Fertilizers	536.83	
Feeding Stuffs	122.04	
Library and Periodicals	534.02	
Tools and Machinery	139.87	
Furniture and Fixtures	786.03	
Scientific Apparatus	399.06	
Traveling by the Board	188.70	
Traveling by the Staff	1,451.56	
Traveling in connection with Adams Fund Investigations	125.81	
Fertilizer Sampling	211.75	
Food Sampling	257.91	
Insurance	1,274.34	
Insect Pest Appropriation to State Entomologist	3,000.00	
Contingent	451.73	
Lockwood Expenses	400.00	
Gypsy Moth Appropriation to State Entomologist	4,150.00	
New Buildings	773.86	
Repairs	793.10	
Grounds	112.27	
Rental of Land	177.50	
		$55,066.96
State Agricultural Appropriation, on hand, Sept. 30, 1910		1,655.26
Total		$56,722.22

NEW HAVEN, CONN., November 1, 1910.

THIS IS TO CERTIFY that we have examined the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the year ending September 30, 1910, have compared the same with the vouchers therefor and find them correct.

WILLIAM P. BAILEY,
EDWARD S. ROBERTS,
Auditors of Public Accounts.

E. H. JENKINS, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ending September 30, 1910.

Receipts and Disbursements in connection with the rebuilding of the laboratory building destroyed by fire January 10, 1910.

RECEIPTS.

Insurance	$11,023.00	
Salvage	41.40	
		$11,064.40
Loan		6,500.00
Total Receipts		$17,564.40

DISBURSEMENTS.

Building	$10,483.61	
Fixtures	5,319.38	
Furniture, Tools and Machinery, Apparatus, Library, Laboratory and Office Supplies, and Miscellaneous	1,594.93	
	$17,397.92	
Department of Fire Service, New Haven	25.00	
Total Disbursements		$17,422.92
Balance on hand September 30, 1910		141.48
		$17,564.40

NEW HAVEN, CONN., November 1, 1910.

THIS CERTIFIES that we have examined the account which relates to loss by fire and rebuilding new building, have compared the same with the vouchers therefor and find them correct.

WILLIAM P. BAILEY,
EDWARD S. ROBERTS,
Auditors of Public Accounts.

ERRATA.

Page 642. Station No. 25269, for Accident read Occident.
642. For Russell Roller Mill Co. read Russell-Miller Milling Co.
642. Atlantic Gluten Feed is wrongly classed as a maize product. Its gluten comes entirely from wheat.
674. Sixteenth line from top, for XXIII read XXVIII.
678. Seventh line from bottom, for XXIII read XXVIII.

PART I.

Report on Commercial Fertilizers, 1909.

By E. H. JENKINS, *Director,* and JOHN PHILLIPS STREET, *Chemist in charge of the Analytical Laboratory.*

This station is required by statute to analyze yearly at least one sample of every commercial fertilizer which is offered for sale in the state. "Stable manure and the products of local manufacturers of less value than ten dollars per ton," are excepted.

The station is also required to publish these analyses yearly.

DUTIES OF MANUFACTURERS AND DEALERS.

The General Statutes, sections 4581 to 4590, inclusive, make the following requirements regarding commercial fertilizers:

1. The seller is responsible for affixing to every package sold, a label which shall correctly give the number of pounds in the package, name of the fertilizer, name and address of the manufacturer, place of manufacture and a statement of composition, expressed in a way approved by this station.

The place of manufacture is the place where the materials which compose the manufactured article are mixed and put together. The manufacturer is the person or firm which owns or controls the manufacturing plant or machinery.

The statement of composition referred to in the statute must conform to the following requirements:

A statement of the percentages of nitrogen, phosphoric acid (P_2O_5) and potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the percentage of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts and "ammonia

The percentages of water-soluble and citrate-soluble phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of, water-soluble and citrate-soluble.

The percentage of acid-soluble phosphoric acid may be stated or omitted.

In case of bone, fish, tankage, dried meat, dried blood, etc., the statement of chemical composition must take account of the two ingredients, nitrogen and phosphoric acid.

For potash salts the percentage of potash (potassium oxide) must always be given; that of sulphate of potash or muriate of potash may also be stated.

2. The seller is responsible for the payment to the station director, on or before May first, annually, of an analysis fee on every brand sold by him.

The analysis fee for any brand will usually be ten, twenty or thirty dollars, according as one, two, or all three of the ingredients—nitrogen, phosphoric acid and potash—are contained or claimed to exist in the fertilizer.

3. Before any brand of fertilizer is sold in the state, the agent or seller must file with the director of this station two certified copies of the statement named in 1, and a sealed glass jar containing not less than one pound of the fertilizer, with an affidavit that it is a fair average sample.

The agent or seller is free from the three obligations just stated only when the manufacturer or importer fulfils them instead.

4. In any case the agent or seller must annually report to the director of this station his name, residence and post office address and the name of the fertilizers which he sells, with the names and addresses of the manufacturers or importers.

OBSERVANCE OF THE FERTILIZER LAW.

During 1909, forty individuals or firms have entered for sale in this state three hundred and sixteen brands of fertilizers, viz:

Special manures for particular crops	154
Other nitrogenous superphosphates	96
Bone manures and "bone and potash"	22
Fish, tankage, castor pomace and chemicals	44
Total	316

Here follows a list of manufacturers who have paid analysis fees as required by the fertilizer law, and the names or brands of the fertilizers for which fees have been thus paid for the year ending May 1st, 1910. No others than those named below have been legally sold in this state.

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 2 Rector St., N. Y. City.	A. A. C. Co.'s Complete Manure with 10% Potash,
	Complete Tobacco Manure,
	" " " (Carb.),
	Grass and Lawn Top Dressing,
	H. G. Tobacco Manure,
	Potato Fertilizer,
	Tobacco Starter and Grower,
	Dry Ground Fish,
	Fine Ground Bone,
	Grass and Oats Fertilizer,
	Acid Phosphate,
	Muriate of Potash,
	Nitrate of Soda,
	Bradley's Complete Manure for Potatoes and Vegetables,
	Complete Manure for Top Dressing Grass and Grain,
	Corn Phosphate,
	Eclipse Phosphate,
	Farmers' New Method Fertilizer,
	Niagara Phosphate,
	Potato Fertilizer,
	Manure,
	Superphosphate,
	Church's Fish and Potash,
	Crocker's Ammoniated Corn Phosphate,
	Potato, Hop and Tobacco Fertilizer,
	Darling's Blood, Bone and Potash,
	Dissolved Bone and Potash,
	Farm Favorite,
	General Fertilizer,
	Potato Manure,
	East India A. A. Ammoniated Superphosphate,
	Potato Manure,
	Great Eastern General,
	H. G. Vegetable, Vine and Tobacco Fertilizer,
	Northern Corn Special,
	North Western Fish, Bone and Potash,
	Market Garden Phosphate,
	Superphosphate,
	33% Potato Fertilizer,
	Universal Fertilizer,

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The—*Continued.*	Packer's Union Animal Corn Fertilizer, Gardener's Complete Manure, Potato Manure, Universal Fertilizer, Quinnipiac Climax Phosphate, Corn Manure, Market Garden Manure, Phosphate, Potato Manure, Phosphate, Read's Practical Potato Special, Standard Superphosphate, Vegetable & Vine Fertilizer, Wheeler's Bermuda Onion Grower, Corn Fertilizer, Grass and Oats, Havana Tobacco Grower, Potato Manure, W'm's & C's Americus Ammoniated Bone Superphosphate. Corn Phosphate, H. G. Special Fertilizer, Potato Manure, Potato Phosphate.
American Reduction Co. of Pittsburgh, Pittsburgh, Pa.	Tankage.
Armour Fertilizer Works, The, Baltimore, Md.	All Soluble, Ammoniated Bone with Potash, Bone, Blood and Potash, Complete Potato, Corn King, Fish and Potash, Fruit and Root Crop Special, Grain Grower, H. G. Potato, Market Garden, Bone Meal.
Baker, H. J., & Bro., 100 William St., N. Y. City.	Baker's Pure Castor Pomace.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Ammoniated Bone Phosphate, Complete Fertilizer, Grass Special, Long Island Special, Potato and Vegetable Phosphate, Tobacco Special, Ground Bone.
Boardman, F. E., Middletown, Conn.	Boardman's Complete Fertilizer.
Bohl, Valentine, Waterbury, Conn.	Self Recommending Fertilizer.

Firm.	*Brand of Fertilizer.*
;owker Fertilizer Co., 60 Trinity Place, N. Y. City.	Bowker's Bone and Wood Ash Fertilizer, Complete Alkaline Tobacco Grower, Corn Phosphate, Early Potato Manure, Fisherman's Brand Fish and Potash, Gloucester Fish and Potash, Hill and Drill Phosphate, Lawn and Garden Dressing, Market Garden Fertilizer, Potato and Vegetable Fertilizer, Potato and Vegetable Phosphate, Sure Crop Phosphate, Tobacco Starter, Fine Ground Dry Fish, Fresh Ground Bone, Pure Unleached Canada Hard Wood Ashes, Tobacco Ash Elements, Acid Phosphate, Stockbridge Special Complete Manure for Corn and Grain, Stockbridge Special Complete Manure for Potatoes and Vegetables, Stockbridge Special Complete Manure for Seeding Down, Stockbridge Special Complete Manure for Top Dressing, Stockbridge Tobacco Manure, Fresh Milled Kainit, Muriate of Potash, Nitrate of Soda.
;road Brook Lumber and Coal Co., The, Broad Brook, Conn.	Broad Brook Special.
;uffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Tobacco Producer, Celery and Potato Special, Farmers' Choice, Fish Guano, H. G. Manure, New England Special, Top Dresser, Vegetable and Potato, Bone Meal.
lark Seed Co., Everett B., The, Milford, Conn.	Clark's Special Mixture for General Use, Special 10% Brand.
oe-Mortimer Co., The, 24-26 Stone St., N. Y. City.	E. Frank Coe's Celebrated Special Potato Fertilizer, E. Frank Coe's Gold Brand Excelsior Guano,

Firm.	*Brand of Fertilizer.*
Coe-Mortimer Co., The—*Continued.*	E. Frank Coe's H. G. Ammoniate Bone Superphosphate, E. Frank Coe's New Englander Corn and Potato Fertilizer, E. Frank Coe's Red Brand Excelsior Guano, E. Frank Coe's Tobacco and Onion Fertilizer, Genuine Peruvian Guano, Lobos Grade, Peruvian Vegetable Grower, Muriate of Potash, Nitrate of Soda, Sulphate of Potash, Thomas Phosphate Powder, Tankage.
Conn. Fat Rendering and Fertilizing Corp'n, New Haven, Conn.	Tankage.
Conn. Valley Orchard Co., Berlin, Conn.	C. V. O. Co's H. G. Special.
Cooper's Glue Factory, Peter, 13 Burling Slip, N. Y. City.	Pure Bone Dust.
Dennis, George L., Stafford Springs, Conn.	Bone.
Eldredge, T. H., Norwich, Conn.	Eldredge's Special Fish and Potash Fertilizer, Superphosphate.
Essex Fertilizer Co., 39 North Market St., Boston, Mass.	Essex Complete for Potatoes, Roots and Vegetables, Market Garden and Potato Manure, Special Tobacco Manure, Tobacco Starter and Grower, XXX Fish and Potash, Complete Manure for Corn, Grain and Grass, Fertilizer for Grass and Top Dressing, Dry Ground Fish, Ground Bone.
Frisbie, L. T., Co., The, New Haven, Conn.	Frisbie's Corn and Grain Fertilizer, Potato Manure, Fine Bone Meal.
Germofert Mfg. Co., 21 Broad St., Charleston, S. C.	Germofert Patented Fruit and Flower Developer, Potato Manure, Special Cotton Grower.
James, Ernest L., Warrenville, Conn.	James' Bone Phosphate, Ground Bone.

Firm.	*Brand of Fertilizer.*
Lister's Agricultural Chemical Works, Newark, N. J.	Lister's Ammoniated Dissolved Bon Phosphate, Grass and Oat Fertilizer, No. 2 Corn Fertilizer, Potato Manure, Special Corn Fertilizer, Grass Mixture, Potato Fertilizer, Tobacco Fertilizer, Standard Pure Bone Super phosphate of Lime, Success Fertilizer, 3-6-10 for Potatoes, Animal Bone and Potash, Celebrated Ground Bone Aci ulated.
Manchester, E., & Sons, Winsted, Conn.	Manchester's Formula.
Mapes F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Average Soil Complete Manure, Cereal Brand, Complete Manure "A" Brand, Corn Manure, Economical Potato Manure, Fruit and Vine, Potato Manure, Seeding Down Manure, Tobacco Ash Constituents, Manure, Wrapper Brand, Starter, Improved, Top Dresser, Improved, Full Strength Half Strengt Vegetable Manure, or Complete Manu for Light Soils, Dissolved Bone.
National Fertilizer Co., The, 60 Trinity Place, N. Y. City.	Chittenden's Ammoniated Bone Pho phate, Complete Grass Fert lizer, Root Fertilize Tobacco Fert lizer, Conn. Valley Tobac Grower, Conn. Valley Tobac Starter, Eureka Potato Fertilizer Fish and Potash, Formula "A," H. G. Special Tobac Fertilizer, Market Garden Fertilize Potato Phosphate, Tobacco Special with Ca bonate of Potash, Universal Phosphate, XXX Fish and Potash,

Firm.	*Brand of Fertilizer.*
National Fertilizer Co., The—*Continued.*	Chittenden's Dry Ground Fish, Ground Bone, Soluble Bone and Potash, Fresh Milled Kainit, Muriate of Potash, Nitrate of Soda.
New England Fertilizer Co., 40A North Market St., Boston, Mass.	Corn and Grain Fertilizer, Corn Phosphate, H. G. Potato Fertilizer, Perfect Tobacco Grower, Potato Fertilizer, Superphosphate, Ground Bone.
Niantic Menhaden Oil and Guano Co., The, South Lyme, Conn.	Bone, Fish and Potash, Corn and Grain Fertilizer, Market Garden Manure, Potato and Vegetable Manure, Acidulated Fish Guano, Dry Ground Fish Guano.
Nitrate Agencies Co., 64 Stone St., N. Y. City.	Nitrate of Soda.
Olds & Whipple, Hartford, Conn.	O. & W.'s Complete Tobacco Fertilizer, Corn and Potato Fertilizer, Fish and Potash, Grass Fertilizer, H. G. Potato Fertilizer, Special Phosphate, Dry Ground Fish, Grey Pomace, Vegetable Potash.
Parmenter & Polsey Fertilizer Co., 40 North Market St., Boston, Mass.	"A. A." Brand, P. & P. Potato Fertilizer, Plymouth Rock Brand, Special Potato Fertilizer, Muriate of Potash.
Pulverized Manure Co., The, 28 Exchange Ave., Chicago.	Wizard Brand Manure.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Complete Phosphate, Fertilizer for Oats and Top Dressing, Grass and Grain Fertilizer, New Market Garden Phosphate, Potato Phosphate, Soluble Corn and General Crops Manure, Potato Manure, Tobacco Manure, Pure Raw Knuckle Bone Flour, Strictly Pure Fine Bone.

Firm.	*Brand of Fertilizer.*
Rogers Mfg. Co., The, Rockfall, Conn.	All Round, Complete Corn and Onion, Potato and Vegetable, Fish and Potash, H. G. Grass and Grain, Oats and Top Dressing, Soluble Tobacco, Tobacco and Potato, Tobacco Grower, Tobacco Starter, Knuckle Bone Flour, Pure Fine Ground Bone.
Sanderson Fertilizer and Chemical Co., New Haven, Conn.	Atlantic Coast Bone, Fish and Potash, Kelsey's Bone, Fish and Potash. Sanderson's Corn Superphosphate, Formula A, B for Tobacco, Potato Manure, Special with 10% Potash, Top Dressing for Grass and Grains, Fine Ground Bone, Fish, Superphosphate with Potash, Muriate of Potash, Nitrate of Soda.
Shay, C. M., Fertilizer Co., The, Groton, Conn.	Shay's Corn Fertilizer, Grass and Lawn, Potato, Pure Ground Bone, Tankage.
Shoemaker, M. L., & Co., Venango St. and Delaware Ave., Philadelphia, Pa.	"Swift-Sure" Superphosphate for General Use, Superphosphate for Potatoes, Superphosphate for Truck, Corn and Onions, Bone Meal.
Swift's Lowell Fertilizer Co., 40 North Market St., Boston, Mass.	Swift's Lowell Animal Brand, Bone Fertilizer, Dissolved Bone and Potash, Empress Brand, Potato Manure, Phosphate, Ground Bone, Swift's Market Garden Manure, Perfect Tobacco Grower, Potato Grower, Special Corn and Vegetable Manure, Grass Mixture,

Firm.	*Brand of Fertilizer.*
Swift's Lowell Fertilizer Co.,—*Continued.*	Swift's Superior Fertilizer with 10 Potash, Tobacco Manure, Acid Phosphate, Muriate of Potash, Nitrate of Soda.
Wheeler, A. G. & F., Stonington, Conn.	Wheeler's Potato Special.
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox's Complete Bone Superphosphate, Fish and Potash, Grass Fertilizer, H. G. Fish and Potash, Tobacco Special, Potato Fertilizer, Onion and Vegetable Manure, Special Superphosphate, Dry Ground Acidulated Fish Fish, Pure Ground Bone, Acid Phosphate, H. G. Sulphate of Potash, Muriate of Potash, Nitrate of Soda.
Woodruff, S. D., & Sons, Orange, Conn.	Woodruff's Home Mixture.

The analyses which follow are chiefly useful as a guide in making purchases for the next year. Most of them are of brands which are offered year after year in Connecticut and the analyses serve to show whether or not these brands are maintaining their original quality.

The larger part of the year's supply of fertilizers is shipped into the state just before planting time, much of it after river navigation is opened. Many brands are not in market till the middle of April. Obviously these conditions make it impossible for the station to sample and analyze all the brands of fertilizers sold in Connecticut and tabulate and publish the results in time to show the composition of all of them before they are bought and applied.

When new brands are offered, the station endeavors to analyze such brands at once and to distribute the report of the results as quickly and widely as possible. Farmers can aid greatly by calling the attention of the station promptly to new kinds of fertilizers which are offered for sale.

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited ninety-eight towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	5
Hartford County	30
Tolland County	11
Windham County	9
New London County	8
Middlesex County	7
New Haven County	16
Fairfield County	12
	98

In these places six hundred and eighty-four samples were taken.

The agent did not find on sale the following brands: American Agricultural Chemical Co.'s Potato Fertilizer, Stockbridge Seeding Down Manure, Lister's Pure Bone Superphosphate of Lime, Parmenter & Polsey's "A. A." Brand, Swift's Lowell Special Grass, Acid Phosphate, Muriate of Potash and Nitrate of Soda, Wheeler's Grass and Oats Fertilizer, The American Agricultural Chemical Co.'s Complete Tobacco Manure (without Carbonate).

As no samples of any of these brands were deposited by the manufacturers at the station, it was impossible to make analyses of them.

With these exceptions, an analysis has been made of every brand of fertilizer which has been entered at the station for sale in Connecticut.

When several samples of a single brand are drawn in different parts of the state, the analysis is usually performed, not on any single sample, but on a mixture made of equal weights of all of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of single samples.

The station agent is instructed in every case to open at least three packages of each brand for sampling, and, if the number of packages is large, to take a portion from every tenth one, by

means of a sampling tube which withdraws a section or core diagonally through the entire length of the bag or barrel.

As a rule, the station will not analyze samples taken from dealer's stock of less than one ton, from stock which has lain over from last season, or from stock which is improperly stored, as in bags lying on wet ground, or exposed to the weather, etc.

The station also analyzes fertilizers sent by purchasers, if the analyses can possibly be of general value and if the samples are taken in strict accordance with the station's instructions for sampling and the correctness of the sample is duly certified.

A sample taken carelessly or incorrectly is quite certain to work injustice both to the seller and buyer. Accuracy of sampling is just as necessary as accuracy of analysis. The sampling is, in reality, a very important part of the analysis.

ANALYSES OF FERTILIZERS.

During the year 737 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given below and the results of their examination are given in detail in the following pages.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed, a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for correction or protest, before the results are published.

DESCRIPTIONS AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages were drawn by the station agent, unless the contrary is stated.

The analyses were made by the methods adopted by the Association of Official Agricultural Chemists and the results are always expressed in percentages, or parts per hundred by weight, of the material examined.

Every percentage given has been determined by two separate analyses, usually made by two chemists working independently, and all calculations are also made in duplicate.

* The analyses of fertilizers included in this chapter have been made by Mr. Street, chemist in charge, with the assistance of Messrs. Bailey, Morrison, Brautlecht and Rodman, station chemists, and of Mr. Lange. The results have been discussed by the director.

In order to avoid confusion, each sample, as it is received, is given a consecutive number, by which it is distinguished in the laboratory. As the numbers had become so large as to be somewhat unwieldy, the numbering was begun again at unity in 1900.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

	Number of Samples.
1. *Containing nitrogen as the chief active ingredient.*	
Nitrate of soda	16
Dried blood	3
Cotton seed meal	217
Castor pomace	6
2. *Containing phosphoric acid as the chief active ingredient.*	
Basic slag, ground phosphate rock, burned bone, etc.	10
Dissolved phosphate rock	13
3. *Containing potash as the chief active ingredient.*	
Muriates and sulphates	21
Kainit	3
"Vegetable potash"	2
4. *Containing nitrogen and phosphoric acid.*	
Bone manures	26
Slaughter house tankage	19
Garbage tankage	3
Dried fish	20
5. *Mixed fertilizers.*	
Dissolved bone and potash	3
Nitrogenous superphosphates and guanos	116
Special manures	161
Home mixtures	17
6. *Miscellaneous fertilizers, manures and amendments*	81
	737

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of soda is mined in Chili and purified there before shipment. As offered in the Connecticut market it contains about 15.50 per cent. of nitrogen, equivalent to 94.1 per cent. of pure sodium nitrate. The other usual constituents are moisture and small quantities of common salt and Glauber's salt.

Shipments differ somewhat in composition, as is shown by the sixteen samples which have been analyzed, as follows:

22395. Sampled from stock of Chas. R. Treat, Orange.

22438. Sold by The Coe-Mortimer Co., New York. Sampled from stock of J. G. Schwink, Meriden.

22660. Sold by Buffalo Fertilizer Co., Buffalo, N. Y. Sampled from stock of S. L. Tuttle, Wallingford.

22810. Sampled and sent by Thos. J. Pring & Bros., Wallingford.

22719. Sold by Bowker Fertilizer Co., New York. Sampled from stock of J. Frank Ellwood, Green's Farms.

22665. Sold by Nitrate Agencies Co., New York. Sampled from stock of H. H. McKnight, Ellington.

22531. Sold by The National Fertilizer Co., New York. Sampled and sent by Henry Davis, Thompsonville.

22456. Sold by The American Agricultural Chemical Co., New York. Sampled from stock of F. S. Bidwell & Co., Windsor Locks.

22691. Sold by E. Aspinall, New York. Sampled and sent by Andrew Kingsbury, Rockville, Conn.

ANALYSES OF NITRATE OF SODA.

	Charles B. Treat.	Coe-Mortimer Co.	Buffalo Fertilizer Co.	T. J. Pring & Bros.	Bowker.	Nitrate Agencies Co.	National Fertilizer Co.	A. A. Co.
ation No.	22395	22438	22660	22810	22719	22665	22531	224
Percentage amounts of								
itrogen found	15.70	15.34	15.64	15.48	15.40	15.52	15.44	15.
itrogen guaranteed	15.65	15.00	15.00	15.00	15.00	15.00	15.00	15.
ost per ton	$47.80*	48.00	50.00	50.00	50.00	52.50	52.40	54.
itrogen cost cents per pound	**15.2**	**15.6**	**16.0**	**16.1**	**16.2**	**16.9**	**17.0**	**17**

* Mixed car lot.

	E. Aspinall.	Coe-Mortimer Co.	National Fertilizer Co.	Wilcox Fertilizer Works.	Sanderson F. & C. Co.	Coe-Mortimer Co.	A. A. C. Co.	Woo ruff.
ation No.	22691	22472	22459	22465	22425	22535	22403	223
Percentage amounts of								
itrogen found	15.68	15.44	15.32	15.40	15.54	15.44	15.54	15.
itrogen guaranteed	15.65	15.00	15.00	15.00	15.00	15.00	15.63	...
ost per ton	55.00	54.00	55.00	56.00	57.00	....	....	...
itrogen cost cents per pound	**17.5**	**17.5**	**18.0**	**18.2**	**18.3**	....	....	...

The percentage of nitrogen ranges from 15.70 to 15.20 and averages 15.48, 0.1 gher than last year.

The retail cost of nitrogen ranges from 15.6 to 18.3, the average being 17.1 cent r pound.

22472. Sold by The Coe-Mortimer Co., New York. Sampled and sent by S. R. Spencer, Suffield.

22459. Sold by The National Fertilizer Co., New York. Sampled from stock of H. A. Bugbee, Willimantic.

22465. Sold by The Wilcox Fertilizer Works, Mystic. Sampled from stock at factory.

22425. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled from stock at factory.

22535. Sold by The Coe-Mortimer Co., New York. Sampled from stock of Connecticut School for Boys, Meriden.

22403. Sold by The American Agricultural Chemical Co., New York. Sampled from stock of Andrew Ure, Highwood.

22388. Sampled from stock of S. D. Woodruff & Sons, Orange.

DRIED BLOOD.

Blood collected in slaughter houses is coagulated by cooking and from the coagulum the water is removed by pressure and kiln drying. Thus prepared it contains about 14 per cent. of nitrogen, but often other materials are mixed with the blood which reduce the nitrogen percentage in the product.

If blood is dried at a low heat its nitrogen is quickly available to plants, but if overheated its value as a fertilizer may be much impaired.

22406. Sold by The American Agricultural Chemical Co., New York. Sampled from stock of Andrew Ure, Highwood. Nitrogen found 10.35 per cent.; guaranteed 9.80.

22160. Sold by the Trenton Fertilizer Co., Trenton, N. J. Sampled and sent by W. H. Shumway, Berlin. It was sold for $4.00 per 100 lbs. It contained 13.32 per cent. of nitrogen, 0.54 per cent. of phosphoric acid and 0.59 per cent. of water-soluble potash.

22965. Sampled and sent by E. M. Ives, Meriden, contained 8.90 per cent. of nitrogen.

COTTON SEED MEAL.

(Analyses on pages 16 to 28.)

Decorticated meal is the only kind which Connecticut farmers can afford to buy, either for feed or fertilizer, at ruling prices.

It should contain at least 6.5 per cent. of nitrogen.

Analyses of Cotton Seed Meal.

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22123	Humphreys, Godwin & Co., Olds & Whipple, Hartford	Olds & Whipple	8.22	8.00	$34.00	18.4
22493	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	7.19	7.00	30.25	18.4
22549	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	7.20	7.00	30.50	18.5
22379	H. G. & Co., Memphis, Tenn.	Frank M. Thompson, Warehouse Point	7.23	7.00	30.50	18.5
22128	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	W. C. Sikes, Suffield	6.81	6.50	29.00	18.5
21977	J. E. Soper & Co., Boston, Mass., W. F. Fletcher, Southwick, Mass.	John B. Cannon, Granby	6.96	6.50	29.75	18.6
22415	Arthur Sikes, Suffield	Herman Ude, Suffield	7.05	6.50	30.00	18.6
22150	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros., Suffield	7.30	7.00	31.00	18.6
22149	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	A. E. Pascoe, O. T. Cone, Warehouse Point	7.32	7.00	31.00	18.6
22432	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	7.10	7.00	30.25	18.6
22433	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	7.08	7.00	30.25	18.7
22694	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	Chas. P. Viets, East Granby	7.35	7.00	31.25	18.7
22547	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	7.14	7.00	30.50	18.7
22590	The Hunter Bros. Milling Co., St. Louis, Mo., N. J. Trench, Granby	E. C. Hills, Southwick, Mass.	6.91	6.50	29.70	18.7
22947	S. D. Viets Co., Springfield, Mass.	A. N. Graves, Windsor Locks	6.75	6.50	29.15	18.8
22378	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	7.03	7.00	30.25	18.8
22364	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	7.05	7.00	30.25	18.8
22129	F. W. Brode & Co., Memphis, Tenn.	R. H. Ensign, Simsbury	6.93	6.50	30.00	18.9
22353	Arthur Sikes, Suffield	A. N. Beach, W. Suffield, Miss L. E. Hathaway and others	6.93	6.50	30.00	18.9

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22418	Arthur Sikes, Suffield	H. Fuller, F. R. Soper, J. Welch, C. H. Nelson and others	6.92	6.50	$30.00	18.9
22948	S. D. Viets Co., Springfield, Mass.	A. N. Graves, Windsor Locks	6.66	6.50	29.15	19.0
21821	J. E. Soper & Co., Boston, Mass., W. F. Fletcher, Southwick, Mass.	D. A. Merriam, Granby	6.84	6.50	29.75	19.0
21978	J. E. Soper & Co., Boston, Mass., W. F. Fletcher, Southwick, Mass.	J. B. Cannon, Granby	6.80	6.50	29.75	19.0
22334	Olds & Whipple, Hartford	L. H. Brewer, Hockanum	7.28	7.00	31.50	19.0
22345	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	7.16	7.00	31.00	19.0
22172	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	7.17	7.00	31.00	19.0
22979	American Agricultural Chemical Co., New York	Indian Head Plantations, Tariffville	6.90	8.24	30.00	19.0
22949	S. D. Viets Co., Springfield, Mass.	A. N. Graves, Windsor Locks	6.65	6.50	29.15	19.1
22950	S. D. Viets Co., Springfield, Mass.	A. N. Graves, Windsor Locks	6.65	6.50	29.15	19.1
22599	J. E. Soper & Co., Boston, Mass., Thos. Holt, Southington	Station Agent	6.85	6.50	30.00	19.1
22417	Arthur Sikes, Suffield	E. A. Fuller and others, Suffield	6.98	6.50	30.50	19.1
22349	Arthur Sikes, Suffield	C. F. Whittemore, Suffield	6.86	6.50	30.00	19.1
22368	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.91	7.41	34.00	19.1
22162	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	James Gamble, Thompsonville	7.18	7.00	31.25	19.1
22504	Planters' Oil Co., Albany, Ga., E. N. Austin, Suffield	H. W. Prout, Suffield	6.62	6.58	29.25	19.2
22598	Geo. B. Robinson, Jr., New York, W. K. Ackley, East Hartford	W. K. Ackley, East Hartford	7.10	6.50	31.00	19.2
22151	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	G. W. Root and others, West Suffield	7.33	7.00	32.00	19.2

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
22580	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.10	7.00	$31.00	19.2
22402	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	The Bissell-Graves Co., Suffield	6.90	7.00	30.25	19.2
22107	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville, Chas. Chapin, Enfield	7.16	7.00	31.25	19.2
22392	S. D. Viets Co., Springfield, Mass., James Price, Warehouse Point	James Price, Warehouse Point	6.81	6.50	30.00	19.2
22946	S. D. Viets Co., Springfield, Mass.	A. N. Graves, Windsor Locks	6.58	6.50	29.15	19.3
22393	H. G. & Co., Memphis, Tenn., James Price, Warehouse Point	James Price and others, Warehouse Pt.	6.80	6.50	30.00	19.3
22317	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	H. S. Pomeroy and others, Suffield	7.04	7.00	31.00	19.3
22410	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.32	7.00	32.00	19.3
22408	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.29	7.00	32.00	19.3
22593	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.08	7.00	35.00	19.3
22522	Olds & Whipple, Hartford	Martin Roberts, Silver Lane	7.31	7.00	32.00	19.3
22726	Planters' Oil Co., Albany, Ga., E. N. Austin, Suffield	E. N. Austin	6.61	6.58	29.25	19.3
22628	Arthur Sikes, Suffield	H. D. Sikes & S. H. Graham, Suffield	6.84	6.50	30.25	19.3
22592	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.06	7.00	35.00	19.4
22527	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	8.06	7.82	35.00	19.4
22328	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.28	7.20	32.00	19.4
22343	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.00	6.50	31.00	19.4
22409	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.00	7.00	31.00	19.4
22442	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	W. R. Messenger, Granby	7.08	7.00	31.25	19.4
22627	Arthur Sikes, Suffield	Geo. S. Phelps, T. F. Devine, Suffield	6.71	6.50	30.00	19.5

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
22416	Arthur Sikes, Suffield	W. A. Soper, W. C. Smith, F. S. Chapell, Suffield	6.99	6.50	$31.00	19.5
22565	Planters' Oil Co., Albany, Ga., E. N. Austin, Suffield	C. A. Prout, Suffield	6.54	6.58	29.25	19.5
22012	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.11	7.20	31.50	19.5
22013	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.10	7.20	31.50	19.5
22037	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.10	7.20	31.50	19.5
22323	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.22	7.20	32.00	19.5
22528	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	8.02	7.82	35.00	19.5
22365	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.75	7.41	34.00	19.5
22583	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros., Suffield, Gantley Bros., Windsor Locks	6.98	6.50	31.00	19.5
22340	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.98	6.50	31.00	19.5
22342	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.96	6.50	31.00	19.5
22604	F. W. Brode & Co., Memphis, Tenn., S. L. Tuttle, Wallingford	Station Agent	6.70	6.50	30.00	19.5
22351	Arthur Sikes, Suffield	W. E. Russell, G. B. Parks, Suffield	6.68	6.50	30.00	19.6
22350	Arthur Sikes, Suffield	D. L. Brockett, H. A. Henshaw, N. A. Talmadge, J. Holzapfel	6.68	6.50	30.00	19.6
22407	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.20	7.00	32.00	19.6
22341	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros., C. C. Bissell, Suffield	7.20	7.00	32.00	19.6

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22412	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.21	7.00	$32.00	19.6
22441	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	Mrs. J. R. Holcomb, Granby	7.01	7.00	31.25	19.6
22499	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	W. R. Messenger, Granby	6.99	7.00	31.25	19.6
22723	S. D. Viets Co., Springfield, Mass., James McCarl, Suffield	Station Agent	6.57	----	29.50	19.6
22728	S. D. Viets Co., Springfield, Mass.	E. S. Seymour, Suffield	6.60	6.50	29.65	19.6
22038	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple, Hartford	7.04	7.20	31.50	19.7
22625	Arthur Sikes, Suffield	D. I. King, Suffield	6.66	6.50	30.00	19.7
22153	American Cotton Oil Co., New York, Spencer Bros., Suffield	Jas. H. Sullivan, John Sullivan, Suffield	6.37	6.18	29.00	19.8
22319	American Cotton Oil Co., New York, Spencer Bros., Suffield	B. L. Root, John Sullivan, Suffield	6.38	6.18	29.00	19.8
22729	H. G & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.86	6.50	31.00	19.8
22784	S. D. Viets, Springfield, Mass.	E. S. Seymour, Suffield	6.54	6.50	29.65	19.8
22624	Arthur Sikes, Suffield.	James Davis & R. H. Loomis, Suffield	6.62	6.50	30.00	19.8
22006	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. & A. B. Crane, Suffield	6.84	6.50	31.00	19.9
22152	American Cotton Oil Co., New York, Spencer Bros., Suffield	Jas. H. Sullivan and John Sullivan, Suffield	6.32	6.18	29.00	19.9
22355	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.58	7.41	34.00	19.9
22366	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.60	7.41	34.00	19.9
22380	Hunter Bros. Milling Co., St. Louis, Mo., V. E. Moore, Springfield, Mass.	J. Lynch & Son, Thompsonville	6.72	6.50	30.50	19.9

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22725	American Cotton Oil Co., England, Ark., James Price, Warehouse Point	Geo. S. Phelps and W. H. Daley, Warehouse Point	6.58	6.50	$30.00	**19.9**
22354	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.57	7.41	34.00	**20.0**
22526	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.79	7.82	35.00	**20.0**
22591	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.18	7.41	36.50	**20.0**
22546	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	Arthur Beeman, Granby	6.98	7.00	31.75	**20.0**
22491	H. G. & Co., Memphis, Tenn., The Loomis Bros. Co., Granby	H. W. Viets, Granby	6.88	7.00	31.25	**20.0**
21990	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	6.62	6.50	30.25	**20.0**
22039	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	H. K. Brainard	6.69	....	30.50	**20.0**
22130	F. W. Brode & Co., Memphis, Tenn.	R. H. Ensign, Simsbury	6.56	6.50	30.00	**20.0**
22352	Arthur Sikes, Suffield	W. C. Knox and others, Suffield	6.59	6.50	30.25	**20.1**
22321	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.25	7.41	33.00	**20.1**
22318	American Cotton Oil Co., New York, Spencer Bros., Suffield	B. L. Root, John Sullivan, Suffield	6.26	6.18	29.00	**20.1**
22698	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.48	7.00	34.00	**20.2**
22495	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.22	7.00	33.00	**20.2**
22344	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.00	7.00	32.00	**20.2**

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22333	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Christopher Michael, Suffield	7.00	7.00	$32.00	20.2
22329	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Jas. O. Haskins, Suffield	6.24	6.50	29.00	20.2
22464	Planters' Oil Co., Albany, Ga., Edmund Halladay, Suffield	Station Agent	6.50	6.58	30.00	20.2
22715	H. G. & Co., Memphis, Tenn., S. D. Viets Co., Springfield, Mass.	Henry Adams, Suffield	6.28	6.50	29.25	20.3
22173	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.20	7.41	33.00	20.3
22545	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	7.67	....	35.00	20.3
22498	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.20	7.00	33.00	20.3
22494	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.94	7.00	32.00	20.3
22367	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.95	6.50	32.00	20.3
22631	Arthur Sikes, Suffield	A. J. Fish and others, Suffield	6.94	6.50	32.00	20.3
22626	Arthur Sikes, Suffield	E. A. Russell and others, Suffield	6.67	6.50	31.00	20.4
22550	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville	6.78	7.00	31.50	20.4
22859	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.45	....	30.50*	20.5
22860	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.16	....	30.50*	20.5
22861	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.20	....	30.50*	20.5
22862	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.44	....	30.50*	20.5
22863	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.11	....	30.50*	20.5
22864	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.62	....	30.50*	20.5
22865	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.09	....	30.50*	20.5
22866	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.20	....	30.50*	20.5
22867	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.60	....	30.50*	20.5

* On basis of 6.5 per cent. nitrogen.

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22868	American Cotton Oil Co., New York	Conn. Tobacco Corporation, Granby	6.20	----	$30.50*	20.5
22951	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.99	7.41	36.50	20.5
22676	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.38	7.00	34.00	20.5
22331	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	S. J. Colter and others, Suffield	6.88	7.00	32.00	20.5
22582	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros., Suffield, Horace Ellsworth, Windsor	6.59	6.50	31.00	20.6
22695	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.12	7.82	37.25	20.6
22677	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.95	7.70	36.75	20.7
22525	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.30	7.00	34.00	20.7
22497	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.80	6.50	32.00	20.7
22332	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	M. Leahey, West Suffield	6.57	6.50	31.00	20.7
22003	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.56	6.50	31.00	20.7
22981	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.88	7.41	36.50	20.8
22696	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.04	7.82	37.25	20.8
22952	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.82	7.41	36.50	20.9
22982	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.82	7.41	36.50	20.9
22815	H. G. & Co., Memphis, Tenn., W. H. Root, New Milford	Station Agent	6.52	6.17	31.00	20.9

* On basis of 6.5 per cent. nitrogen.

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
22431	Chapin & Co., Boston, Mass., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.75	6.50	$32.00	20.9
22701	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.82	6.58	32.50	21.0
22700	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.90	7.82	37.00	21.0
22734	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	7.98	7.82	37.25	21.0
22732	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	7.95	7.82	37.25	21.0
22581	American Cotton Oil Co., New York, Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.72	6.50	32.00	21.0
22148	American Cotton Oil Co., New York, Spencer Bros., Suffield	Spencer Bros.	6.48	6.50	31.00	21.0
22521	Hunter Bros. Milling Co., St. Louis, Mo., H. C. Stowell, East Granby	Geo. Rengerman, East Granby	6.30	6.50	30.25	21.0
22817	Olds & Whipple, Hartford	Olds & Whipple	8.10	7.82	38.00	21.1
22793	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	8.08	7.82	38.00	21.2
22733	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	7.90	7.82	37.25	21.2
22594	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.06	7.82	38.00	21.2
22476	Hunter Bros. Milling Co., St. Louis, Mo., Somers Grain and Lumber Co., Somers	Avery & Daniels, Somers	7.12	6.50	34.00	21.2
22584	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.33	7.00	35.00	21.3

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
2674	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.08	7.00	$34.00	21.3
2768	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	8.02	7.82	38.00	21.3
2473	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.75	6.50	32.50	21.3
2411	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.38	6.50	31.00	21.3
2629	Arthur Sikes, Suffield	Fred. A. King and others, Suffield	6.40	6.50	31.00	21.3
2818	Olds & Whipple, Hartford	Olds & Whipple	7.98	7.82	38.00	21.4
2673	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.05	7.00	34.00	21.4
2595	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.28	7.00	35.00	21.4
2523	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.30	7.41	35.00	21.4
2727	H. G. & Co., Memphis, Tenn., Broad Brook Lumber and Coal Co., Broad Brook	Harry W. Mohn, Warehouse Point	6.20	6.50	30.50	21.5
2699	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.04	7.00	34.00	21.5
2524	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.60	7.82	36.50	21.5
2716	Chapin & Co., Boston, Mass., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.98	6.50	34.00	21.6
2548	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	L. C. Brainard, Thompsonville, Chas. Tilden, Suffield	6.24	6.50	30.75	21.6
2630	Arthur Sikes, Suffield	C. S. Fuller and T. F. Devine, Suffield	6.50	6.50	32.00	21.7
2872	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.36	7.20	35.75	21.7

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen cost cents per pound.
22678	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.62	6.58	$32.50	21.7
22671	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.93	7.00	34.00	21.8
22675	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.90	7.00	34.00	21.9
22789	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.77	7.82	38.00	22.0
22787	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.76	7.82	38.00	22.0
22597	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.42	7.41	36.50	22.0
22490	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.82	6.58	34.00	22.1
22585	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.38	7.41	36.50	22.2
22697	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.44	6.58	32.50	22.3
22672	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.78	7.00	34.00	22.3
22819	Olds & Whipple, Hartford	Olds & Whipple	7.10	7.20	35.75	22.5
22596	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.26	7.41	36.50	22.5
22765	H. G. & Co., Memphis, Tenn., The Broad Brook L. & C. Co., Broad Brook	The Broad Brook Lumber and Coal Co.	6.25	----	32.00	22.6
22587	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.92	7.00	33.00	22.6

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
22785	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.58	7.82	$38.00	22.6
22714	Buckeye Cotton Oil Co., Greenwood, Miss., Arthur Manning, South Manchester	Station Agent	6.32	6.17	32.50	22.7
22475	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	6.86	7.00	35.00	22.7
22786	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.50	7.82	38.00	22.8
22730	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.62	6.50	34.00	22.8
22496	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.38	6.50	33.00	22.9
22764	H. G. & Co., Memphis, Tenn., The Broad Brook L. & C. Co., Broad Brook	The Broad Brook Lumber and Coal Co.	6.16	....	32.00	22.9
22769	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.96	7.20	35.75	23.0
22766	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.10	7.41	36.50	23.0
22788	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.40	7.82	38.00	23.1
22474	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	6.75	7.00	35.00	23.1
22588	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.52	6.58	34.00	23.2
22792	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.85	7.20	35.75	23.3
22586	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	6.70	7.00	35.00	23.3

Analyses of Cotton Seed Meal—*Concluded.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
22502	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	6.70	7.00	$35.00	23.3
22501	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	6.67	7.00	35.00	23.4
22767	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	7.00	7.41	36.50	23.4
22816	Olds & Whipple, Hartford	Olds & Whipple	6.80	7.20	35.75	23.5
22589	American Cotton Oil Co., New York, J. E. Soper & Co., Boston, and Olds & Whipple, Hartford	Olds & Whipple	6.40	6.58	34.00	23.6
22770	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	6.86	7.41	36.50	23.8
22790	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.17	7.82	38.00	23.9
22731	J. E. Soper & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	5.98	6.50	33.00	24.4
22858	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	6.03	7.82	38.00	28.4
22857	H. G. & Co., Houston, Texas, Olds & Whipple, Hartford	Olds & Whipple	5.98	7.82	38.00	28.6
22635	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.31	6.50	....	....
22636	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros., Suffield, and others	6.68	6.50	....	....
22637	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros., Suffield, and others	7.14	6.50	....	....
22638	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros., Suffield, and others	7.05	6.50	....	....
22639	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	7.35	6.50	....	....
22640	American Cotton Oil Co., New York, Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.57	6.50	....	....
22641	Chapin & Co., Boston, Mass., Spencer Bros., Suffield	Spencer Bros. and others, Suffield	6.68	6.50	....	....

The color or "smoothness" of the meal is no sure indication of its purity, for a considerable quantity of fine ground hulls may be mixed with it and not betray its presence by appearance or feel.

It is now possible, where cotton seed meal is much used, to buy it with a guaranty of composition and to secure from the dealer a rebate in case analysis shows it to be below guaranty.

Two hundred and seventeen samples have been analyzed and in most cases each represented a car lot. Where the station analysis has shown that the meal sample was not as guaranteed, the dealer has in most cases at least made a rebate from the price. The proper sampling of meal is necessary in order to get a correct analysis and to found a claim for a rebate if the analysis shows a deficiency of nitrogen. A sample should be drawn from twenty sacks at least in each car lot, or from fifty sacks in a hundred ton lot. These should be well mixed and a sample of the mixture sent for analysis.

The analyses are given in the preceding table.

The average cost of the meal has been $32.52 per ton, ranging from $29. to $38.

The average percentage of nitrogen has been 7.02, ranging from 8.22 to 5.98.

This is about the same as last year.

The average cost of nitrogen per pound has been 20.5 cents, 1.6 cents higher than last year. For this calculation it is assumed that the samples contain 3.15 per cent. of phosphoric acid and 1.9 per cent. of potash, which are the averages of a large number of determinations.

CASTOR POMACE.

(ANALYSES ON PAGE 30.)

This is the ground residue of castor beans from which castor oil has been expressed or extracted. The nitrogen which it contains is readily available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

Six samples have been analyzed this year, as follows:

Station No.	Sold by	Sampled and sent by
22503	Olds & Whipple, Hartford,	E. S. Seymour, Suffield.
22721	" " " "	Station Agent.
22335	" " " "	L. H. Brewer, Hockanum.
22462	" " " "	Station Agent.
22414	" " " "	Spencer Bros., Suffield.
22458	H. J. Baker & Bro., N. Y.,	Station Agent.

ANALYSES OF CASTOR POMACE.

		Olds & Whipple.				H. J. Baker & Bro.
Station No.	22503	22721	22335	22462	22414	22458
Percentage amounts of						
Nitrogen found	5.48	5.12	5.05	4.96	4.88	4.82
Nitrogen guaranteed	5.00	5.00	5.00	5.00	5.00	4.11
Cost per ton	$24.00	24.00	24.00	24.00	24.00	26.00
Nitrogen costs cents per pound	19.9	21.3	21.6	22.0	22.4	24.7

The percentages of phosphoric acid and potash in castor pomace are 1.95 and 0.98 respectively. The cost of nitrogen is determined in each case by deducting $2.15—the valuation of the phosphoric acid and potash—from the ton price, and dividing the remainder by the number of pounds of nitrogen in a ton of the pomace.

The cost of nitrogen in castor pomace has ranged from 19.9 to 24.7 cents per pound, the average of the six samples being 22.0 cents, 1.5 cents per pound more than in cotton seed meal.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BASIC SLAG PHOSPHATE.

This material is a by-product of the steel manufacture containing from 17 to 19 per cent. of phosphoric acid and 45 to 50 per cent. of lime in finely divided form. The lime is in an efficient form for correcting acidity of the soil. The phosphoric acid is fairly available to plants, though showing small "availability" by the conventional method which is discussed on page 35 of this report. In most cases it will probably be found less quick in its action as a source of phosphoric acid, but more lasting in its effects than acid phosphate.

For top-dressing grass land and for fruit trees it has given very satisfactory results.

The three samples tested were all sold by The Coe-Mortimer Co., New York, under guaranty of 18 per cent. phosphoric acid.

22440. Taken by the station agent from stock of J. G. Schwink, Meriden.

22470. Sampled and sent by S. R. Spencer, Suffield.

22623. Sampled and sent by O. E. Pitcher, Suffield.

ANALYSES OF BASIC SLAG PHOSPHATE.

Station No.	22440	22470	22623
Phosphoric acid	17.32	17.33	17.04
Lime	48.45	.....	.....

GROUND PHOSPHATE ROCK.

The term "floats" is properly applied only to the very fine dust "floated" in an air current from the mills which grind rock to prepare it for treatment with acid and not to the whole ground product, which is much coarser. The use of floats mixed with stable manure has been advocated as the cheapest method of stocking land with phosphates.

The admirable experiments made at the Ohio station give the best knowledge we have on the matter and may be very briefly noticed here, abstracted from Bulletin No. 183 of that station.

Manure which accumulated in the barnyard during the winter was divided into parcels with one of which floats and with another acid phosphate was mixed at the rate of forty pounds to the ton. (This would be about equivalent to one pound per day and head of stock.) Eight tons of each of these two mixtures were used on separate plots of land where corn, wheat and clover were grown in rotation for ten years. The results are calculated from ten weighed crops each of corn and wheat and six crops of hay. (The clover failed in four years and soy beans were sown and turned under in its place.) After deducting the cost of the treatment each application showed a net gain, that is, the use of both the acid phosphate and the floats paid well.

The author of the Bulletin states, page 210:

". . . . it has been unprofitable to use floats instead of acid phosphate, the net return from the manure treated with acid phosphate having been greater than that treated with floats by $2.86 per acre for the yard manure. . . .

"Floats contains about twice as large a percentage of phosphorus as acid phosphate, since floats and sulphuric acid are mixed in approximately equal weights to produce acid phosphate, and hence twice as much phosphorus has been applied to the plots receiving floats as to those receiving acid phosphate. It was expected that, with the progress of the experiment, a larger proportion of the floats would become available, and that the difference in effectiveness between the two materials would

gradually diminish, an expectation which has not yet been realized."

And on page 212:

"It is true that a great deal more phosphorus is being stored in the soil dressed with the manure treated with floats than in that on which the acid phosphate is used for treatment, but it appears that in the latter case considerably more phosphorus is being given to the soil than is taken off in the crops, as shown by the following statement of income and outgo on Plot 6."

The statement referred to shows that manure and acid phosphate supplied 44 lbs. of phosphorus and the crops removed 30 lbs.

Summarizing the results it is stated, page 223:

"The net gain from the use of acid phosphate as a manure reënforcement has been greater than that from floats, and the ton of fresh manure, reënforced with 40 pounds of acid phosphate, has produced a 10-year average increase to the value of $4.57 over and above the cost of treatment, or more than double the increase produced by the ton of untreated yard manure."

It must be remembered that these results were obtained on a soil and with crops which responded well to applications of phosphoric acid. They cannot conclusively settle the relative value of acid phosphate and floats on all soils and under all conditions, but are valuable and suggestive as a guide to tests and practice by individual farmers.

21731. Made by Farmers' Ground Rock Phosphate Co., Mt. Pleasant, Tenn. Sent by Lewis Sperry of East Windsor Hill.

22374. Sent by H. B. Cooke, Georgetown.

22156. "Floats." Sent by Andrew Kingsbury, Rockville.

21822. "Phosphate Rock and Floats." Sent by H. S. Lyman, Manchester.

ANALYSES OF GROUND PHOSPHATE AND FLOATS.

Station No.	21731	22374	22156	21822
Percentage amounts of				
Phosphoric acid found	31.28	24.43	21.59	21.49
" " guaranteed	32.00	.....	25.00	28.00
Cost per ton delivered	$9.25	9.00	9.00	9.00*

* A rebate of $1.50 per ton allowed because it failed to meet the guaranty.

A sample of phosphatic material, **21712**, which is a residue from an iron manufacture, contained 17.01 per cent. of phosphoric acid with 47.31 per cent. of sand and silicates.

BURNED BONE.

22430 is ground bone which has been used for case hardening and by the process has been roasted without access of air. It contains 0.34 per cent. of nitrogen and 41.12 per cent. of phosphoric acid. Such material is but very slowly available until it has been converted into a superphosphate by treatment with oil of vitriol.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK AND DISSOLVED BONE BLACK.

(Analyses on page 34.)

These materials are made by treating various mineral phosphates, spent bone black, or bone with oil of vitriol.

All of the samples analyzed are dissolved rock phosphate excepting **22783**, which is dissolved bone black. **22539** was sold as E. F. Coe's high-grade soluble bone brand. It is, however, dissolved rock phosphate.

22348. Sampled from stock bought by Charles R. Treat, Orange.

22962. Sold by Bowker Fertilizer Co. Sampled from stock of J. F. Elwood, Greens Farms.

22659. Sold by Buffalo Fertilizer Co. Sampled from stock of S. L. Tuttle, Wallingford.

22484. Sold by The American Agricultural Chemical Co. Sampled from stock of Spencer Bros. and E. Halladay, Suffield.

22533. Sold by The National Fertilizer Co. Sampled and sent by Henry Davis, Thompsonville.

22488. Sold by The Wilcox Fertilizer Co. Sampled from their stock.

22666. Sold by the Nitrate Agencies Co. Sampled from stock of H. H. McKnight, Ellington.

22783. Sold by The American Agricultural Chemical Co. Sampled and sent by L. P. Bissell, Suffield.

22692. Bought of a broker. Sampled and sent by Andrew Kingsbury, Rockville.

ANALYSES OF ACID PHOSPHATE AND DISSOLVED BONE BLACK.

Station No.	22348	22962	22659	22484	22533	22488	22666	22783	22692	22539	22362	22404	22389
Percentage amounts of													
Water-soluble phosphoric acid	12.02	10.10	12.39	11.85	12.34	13.63	12.10	14.52	11.86	12.42	14.48	11.60	11.63
Citrate-soluble phosphoric acid	1.91	3.39	2.97	3.49	2.33	2.96	3.02	2.24	2.10	3.51	1.85	3.91	3.81
Citrate-insoluble phosphoric acid	0.68	1.54	0.27	0.91	1.53	2.55	1.19	0.61	0.33	0.19	0.68	0.74	0.42
Total phosphoric acid found	14.61	15.03	15.63	16.25	16.20	19.14	16.31	17.37	14.29	16.12	17.01	16.25	15.86
Total phosphoric acid guaranteed	....	....	17.00	....	....	....	....	....	....	....	....	15.00	....
Sum of water-soluble and citrate-soluble phosphoric acid found	13.93	13.49	15.36	15.34	14.67	16.59	15.12	16.76	13.96	15.93	16.33	15.51	15.44
"Available" phosphoric acid guar.	14.00	14.00	16.00	14.00	14.00	....	14.00	16.00	14.00	14.00	14.00	14.00	14.00
Cost per ton	$11.90*	12.00	15.00	15.00	14.40	17.00	16.00	18.75	16.00	....	....	....	....
"Available" phosphoric acid costs cents per pound	**4.3**	**4.4**	**4.8**	**4.9**	**4.9**	**5.1**	**5.3**	**5.6**	**5.7**	....	....	....	....

* Car lot.

22539. Sold by The Coe-Mortimer Co. Sampled from stock bought by Connecticut School for Boys, Meriden.

22362. Sold by The Rogers Manufacturing Co. Sampled from stock of L. M. Benham, Highwood.

22404. Sold by The American Agricultural Chemical Co. Sampled from stock of Andrew Ure, Highwood.

22389. Sampled from stock of S. D. Woodruff & Sons, Orange.

The cost of "available" phosphoric acid has ranged from 4.4 to 5.7 cents per pound when the acid phosphate has been bought in ton lots. In mixed car lots it has been bought for slightly less than 4 cents.

It needs to be repeated that "available phosphoric acid" is purely a trade name for the sum of the water-soluble and citrate-soluble phosphoric acid and has no necessary connection with the availability of the phosphoric acid to crops. Water-soluble phosphoric acid is comparatively readily available to plants. When applied to the soil it quickly becomes insoluble in water, but exists for a time at least in forms which are easily decomposed and absorbed by the action of the plant roots. This is not by any means equally true of all forms of citrate-soluble phosphoric acid. Some of them are, probably, about as quickly and perfectly "available," in the agricultural sense, as water-soluble phosphates, while others are, by comparison, quite "unavailable," and there is no means, at present known, for determining this difference in the laboratory.

The method of citrate extraction was devised for, and is strictly applicable only to, the determination of that part of the phosphoric acid in a plain superphosphate ("acid phosphate," or dissolved rock phosphate) which had been at first dissolved by sulphuric acid but by further chemical reactions has become insoluble in water and was formerly called "backgone" or "reverted" phosphoric acid.

But when this method is applied to such mixed fertilizers as are now in the trade, containing bone, tankage and sometimes iron and aluminum phosphates, citrate-solution dissolves much phosphate which has not been made more soluble by the manufacture than it was originally, and some of which cannot be considered as being quickly "available" to crops.

Potash Salts. Percentage Composition and Cost Per Pound of Potash.

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton.	Potash costs cents per pound.
	High Grade Sulphate of Potash.					
22439	J. G. Schwink, Meriden, from Coe-Mortimer Co.	Station Agent	52.86	48.0	$48.00	4.5
*22530	Henry Davis, Thompsonville, from National Fertilizer Co.	Henry Davis	49.38	48.0	49.90	5.0
22663	S. L. Tuttle, Wallingford, from Buffalo Fertilizer Co.	Station Agent	48.54	48.6	49.00	5.0
23669	James Price, Warehouse Point, from Parmenter & Polsey Fertilizer Co	James Price	50.88	48.0	51.00	5.0
22717	Wilcox Fertilizer Co.	Station Agent	50.57	48.0	52.00	5.1
22471	S. R. Spencer, Suffield, from Coe-Mortimer Co.	S. R. Spencer	50.89	48.0	54.00	5.3
	Double Sulphate of Potash and Magnesia, "Low Grade Sulphate."					
22538	Conn. School for Boys, Meriden, from Coe-Mortimer Co.	Station Agent	27.13	25.00	....	....
	Muriate of Potash.					
22661	S. L. Tuttle, Wallingford, from Buffalo Fertilizer Co.	Station Agent	53.73	50.0	41.00	3.8
22972	T. J. Pring, Wallingford, from Parmenter & Polsey Fertilizer Co.	Station Agent	51.39	50.0	41.00	4.0
22718	J. F. Elwood, Greens Farms, from Bowker Fertilizer Co.	Station Agent	51.68	50.0	42.00	4.1
22396	Chas. R. Treat, Orange	Station Agent	49.72	50.5	41.40*	4.2
22693	Andrew Kingsbury, Rockville	Andrew Kingsbury	51.30	50.5	44.00	4.3
22529	Henry Davis, Thompsonville, from National Fertilizer Co.	Henry Davis	51.03	49.0	44.90	4.4
22426	Sanderson Fertilizer Co.	Station Agent	50.30	50.0	45.00	4.5

POTASH SALTS. PERCENTAGE COMPOSITION AND COST PER POUND OF POTASH.—*Continued.*

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton.	Potash costs cents per pound.
22427	C. C. Chapman, Thompsonville, from Rogers Mfg. Co.	C. C. Chapman	49.83	50.0	$45.00	4.5
22466	Wilcox Fertilizer Works	Station Agent	49.84	----	46.00	4.6
22455	F. S. Bidwell & Co., Windsor Locks, from American Agr. Chem'l Co.	Station Agent	50.03	49.0	46.00	4.6
22460	H. A. Bugbee, Willimantic, from National Fertilizer Co.	Station Agent	50.90	49.0	48.00	4.7
22402	Andrew Ure, Highwood, from American Agr. Chem'l Co.	Station Agent	50.96	50.0	----	----
22536	Conn. School for Boys, Meriden, from Coe-Mortimer Co.	Station Agent	52 12	50.0	----	----
22363	L. M. Benham, Highwood, from Rogers Mfg. Co.	Station Agent	49 20	----	----	----
	Kainit.					
22436	A. D. Bridge's Sons, Hazardville, from Bowker Fertilizer Co.	Station Agent	12.79	12.0	16.00	6.3
22461	H. A. Bugbee, Willimantic, from National Fertilizer Co.	Station Agent	13.28	12.0	18.00	6.8
22534	*Conn. School for Boys, Meriden, from Coe-Mortimer Co.	Station Agent	13.40	12.0	----	----

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH-GRADE SULPHATE OF POTASH.

(ANALYSES ON PAGE 36.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), or about 49 per cent. of potassium oxide ("potash"), about 1 per cent. less than is contained in muriate, and it should be nearly free from chlorides. The six samples analyzed were of good quality.

The cost of potash in high grade sulphate has been a little over 5 cents a pound.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

(ANALYSIS ON PAGE 36.)

This material is usually sold as "sulphate of potash" or "manure salt," on a guaranty of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, and varying quantities of moisture.

The single sample analyzed was of average composition.

The cost of potash per pound in double sulphate of potash of good quality is usually somewhat higher than in high grade sulphate.

MURIATE OF POTASH.

(ANALYSES ON PAGES 36 AND 37.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), equivalent to 50.5 per cent. of actual potash, 15 per cent. or more of common salt (sodium chloride) and 4 per cent. or more of water.

All of the fourteen samples examined were of standard quality.

The price per pound of actual potash in the muriate has ranged from 3.8 to 4.7 cents.

KAINIT.

(ANALYSES ON PAGE 37.)

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than

that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It usually contains more water than either the sulphate or the muriate of potash and is sold on a guaranty of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It is not properly called, or claimed to be, a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists chiefly as muriate and, to a much less extent, as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

The samples analyzed show the usual range of composition.

VEGETABLE POTASH.

This material, sold by Olds & Whipple, Hartford, is understood to be the ashes of beet residues from the beet sugar manufacture.

22463. Sampled from stock of Olds & Whipple, Hartford.
22336. Sampled and sent by L. H. Brewer, Hockanum.

ANALYSES OF VEGETABLE POTASH.

Station No.	22463	22336
Percentage amounts of		
Potash* calculated as muriate	1.85	2.02
Potash* calculated as sulphate	2.23	2.38
Potash calculated as carbonate	19.71	22.34
Total potash	23.79	26.74
Chlorine	1.39	1.52
Sulphuric acid	1.90	2.02
Cost per ton	$43.00	44.00
Potash costs cents per pound	9.2	8.2

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

(ANALYSES ON PAGES 42 AND 43.)

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" applied to fertilizers, sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have

* See note regarding this calculation, page 104.

been thrown out either raw or after cooking, with more or less meat, tendon and grease, and—if taken from garbage or ash heaps—with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam tanks to recover grease, and are then dried and sometimes sold as "tankage"; or finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are equally fine the nitrogen of all these varieties of bone probably has about the same fertilizing value. But this agricultural value of bone depends very largely on its fineness. It is a matter of common observation that a whole bone may lie in the ground for a good while without going to pieces. Fine grinding increases enormously the surface which plant roots and the disintegrating forces of the soil can act upon and by so doing make the nitrogen and phosphoric acid available. Much of the bone now sold is dry and could be easily ground finer than it usually is, and more attention should be paid, both by manufacturers and purchasers, to the fineness of this material. Increased demand for a fine bone dust will soon make it more common in the market.

The table of analyses of bone manures contains a column headed "Valuation per ton."

Valuation of Fertilizers in General.

The valuation of a fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (in raw materials of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

The trade value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce. *The valuation of a fertilizer does not show either its fair price or agricultural value. Nor should it be inferred that the ingredients of a given mixture always have the market value represented by the valuation.*

The valuation, properly understood and used, does, however, furnish a rational basis for comparing the commercial values of fertilizer mixtures.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, must add to the trade-value of the above-named ingredients a suitable margin for the expenses of manufacture and sale, and for the convenience or other advantage incidental to their use. Valuation no more shows the fair retail price of a fertilizer than quotations of steel billets can show the fair price for small amounts of structural steel of a specified shape. If, however, the prices of steel remain fairly uniform, a

comparison of these with the rates charged by different companies *in open competition* for the finished product is a help, though not a perfect guide, to the buyer in studying the bids of different manufacturers.

TRADE-VALUES OF FERTILIZER ELEMENTS FOR 1909.*

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1908 were as follows:

	Cents per pound.
Nitrogen in nitrates	16½
ammonia salts	17
Organic nitrogen in dry and fine ground fish, meat and blood, and in mixed fertilizers	19
in fine† bone and tankage	19
in coarse† bone and tankage	14
Phosphoric acid, water-soluble	4
citrate-soluble‡	3½
of fine ground bone and tankage	3½
of coarse bone and tankage	3
of cotton seed meal, castor pomace and ashes	3
of mixed fertilizers, if insoluble in ammonium citrate‡	2
Potash as high-grade sulphate in forms free from muriate (or chlorides)	5
as muriate	4¼

The *foregoing are, as nearly as can be estimated, the prices at which*, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail *prices, at the large markets, of standard raw materials.*

VALUATION OF BONE AND TANKAGE.

To obtain the valuation of ground bone the sample is sifted into two grades, that finer than $\frac{1}{50}$ inch, "fine," and that coarser than $\frac{1}{50}$ inch, "coarse." (Continued on p. 44.)

* Adopted at a conference of representatives of the Maine, Massachusetts, New Jersey, Rhode Island, Vermont and Connecticut stations held in March, 1909.

† In this report "fine," as appplied to bone and tankage, signifies smaller than $\frac{1}{50}$ inch; and "coarse," larger than $\frac{1}{50}$ inch.

‡ Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" phosphoric acid.

PERCENTAGE COMPOSITION AND

Station No.	Name or Brand.	Manufacturer.
	Sampled by Station Agent.	
22995	Rogers' Fine Ground Bone	Rogers' Manufacturing Co., Rock
22291	Frisbie's Bone Meal	L. T. Frisbie Co., New Haven
23000	Swift-Sure Bone Meal	M. L. Shoemaker & Co.
22360	Rogers' Fine Knuckle Bone Flour	Rogers' Manufacturing Co., Rock
22657	Buffalo Bone Meal	Buffalo Fertilizer Co.
23001	Swift's Lowell Ground Bone	Swift's Lowell Fertilizer Co.
22989	Dennis' Ground Bone	G. L. Dennis, Stafford Springs
22990	Essex Ground Bone	Essex Fertilizer Co., Boston
22814	Berkshire Ground Bone	Berkshire Fertilizer Co., Bridgeport
22988	Cooper's Pure Bone Dust	Peter Cooper's Glue Factory
22812	A. A. C. Co.'s Bone Meal	American Agl. Chem. Co.
22813	Armour's Bone Meal	Armour Fertilizer Works
3002	Wilcox's Pure Ground Bone	Wilcox Fertilizer Works, Mystic
2994	New England Ground Bone	New England Fertilizer Co.
2998	Sanderson's Fine Ground Bone	Sanderson Fertilizer and Chemical (
2987	Bowker's Fresh Ground Bone	Bowker Fertilizer Co.
2999*	Shay's Pure Ground Bone	C. M. Shay Fertilizer Co., Groton
997	Hubbard's Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middl town
996	Hubbard's Pure Fine Bone	The Rogers & Hubbard Co., Middl town
992	Lister's Celebrated Ground Bone Acidulated	Lister's Agricultural Chemical Works
993	Chittenden's Ground Bone	National Fertilizer Co.
	Sampled by purchasers and others.	
570	P. & P.'s Ground Bone	Parmenter & Polsey Fertilizer Co.
94	Sanderson's Ground Bone	Sanderson Fertilizer and Chemical Co
03	James' Ground Bone	E. L. James, Warrenville
35	Sanderson's Ground Bone	Sanderson Fertilizer and Chemical Co
61	Ground Bone	Springfield Rendering Co.

* See note on page 44.

VALUATION OF BONE MANURES.

Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechan Analys
				Nitrogen.		Phosphoric acid.		
				Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.
Manufacturer	$32.00	$31.22	2.5	3.63	3.25	26.87	26.0	78
E. Rogers,* Southington	28.00	26.04	7.5	3.80	3.30	22.44	18.0	32
Spencer Bros., Suffield	36.00	33.16	8.6	5.40	4.53	23.92	20.0	47
L. M. Benham, Highwood	35.00	31.49	11.1	4.09	3.80	25.84	25.0	68
Ansonia Flour and Grain Co., Ansonia	28.00	24.92	13.6	2.20	2.87	25.84	22.0	68
[. Reinhard & Sons, Cheshire	30.00							
S. L. Tuttle,* Wallingford	27.00							
	28.30							
H. K. Brainard, Thompsonville	34.00	28.18	13.6	2.97	2.47	26.38	23.0	72
F. S. Bidwell & Co., Wind. Locks	30.00							
	32.00							
Manufacturer	28.00	24.59	13.9	3.82	3.00	21.82	20.0	13
F. T. Blish Hardware Co., So. Manchester	30.00	25.92	15.7	2.54	2.50	26.99	23.0	50
Hotchkiss & Templeton	30.00	25.79	16.3	3.68	2.50	21.54	20.0	44
T. H. Eldredge, Norwich	30.00	25.22	19.0	2.02	2.50	29.32	26.0	40
Raymond Bros., South Norwalk	30.00	24.56	22.1	2.58	2.47	24.22	23.0	56
E. A. Buck & Co., Willimantic	34.00	26.95	22.4	2.93	2.47	25.74	24.0	60
Farmers Supply Co., Bridgeport	32.00							
	33.00							
Manufacturer	30.00	24.27	23.6	1.80†	2.47	28.09	24.0	51
T. B. Atwater, Plantsville	30.00	24.08	24.6	1.82	2.46	26.43	23.0	70
Manufacturer	30.00	22.97	30.6	1.91	2.50	25.00	20.0	59
R. H. Hall, East Hampton	30.00							
Lightbourn & Pond Co., New Haven	33.00	24.35	31.4	2.72	2.50	23.97	20.0	46
A. D. Bridge's Sons, Hazardville	31.00							
	32.00							
Knowles-Lombard Co., Guilford	33.00	25.04	31.8	2.39	2.70	25.96	25.0	55
G. M. Williams Co., N. London	33.00							
Manufacturer	38.00	28.82	31.9	3.88	3.50	25.43	24.5	42
F. S. Platt Co., New Haven	35.00	25.80	35.7	3.43	2.85	23.03	22.0	41
C. H. Sage, East Canaan	27.00	17.89	50.9	3.40	2.70	10.87	12.0	41
H. A. Bugbee, Willimantic	30.00	18.89	58.8	1.97	1.65	18.98	13.7	51
Sampled or sent by								
James Price, Warehouse Point	28.00	24.21	15.6	1.90	2.47	25.96	23.0	73
D. G. Beard, Shelton	28.00	23.99	16.7	2.40	2.05	24.46	20.0	53
Manufacturer	29.00	24.79	17.0	4.17	3.00	21.44	20.0	4
D. G. Beard, Shelton	28.00	21.96	27.5	2.09	2.50	22.80	20.0	55
George Wilcox, Shaker Station	----	----	---	2.00	---	28.20	----	----

* Purchaser.

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying the product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample.

1. *Bone Manures Sampled by the Station Agent.*

In the tables on pages 42 and 43 are tabulated analyses of twenty-one samples.

GUARANTIES.

Of the samples having a guaranty, seven failed in one particular to meet it but the deficiency was met by a corresponding excess of the other ingredient in most cases, so that a full money equivalent was given for the plant food guaranteed.

22999. Shay's Pure Ground Bone contained 2.39 per cent. of nitrogen and 25.96 of phosphoric acid, the guaranteed percentages being 2.70 and 25 respectively.

COST AND VALUATION.

The average cost per ton of the 21 brands examined was $31.30 and the valuation $25.72. The average cost is nearly a dollar greater than last year and the average valuation nearly three dollars less.

2. *Sampled by Others than the Station Agent.*

In the tables on pages 42 and 43 are included five analyses of samples drawn by others than the station agent. The station is responsible only for the analyses, but not for the correctness of the sampling of these.

SLAUGHTER-HOUSE TANKAGE.

(Analyses on page 46.)

After boiling or steaming various slaughter-house wastes, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. Tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone.

In the table are analyses of nineteen samples of this material from the Connecticut market.

In several cases the valuation exceeds the cost and the average cost differs from the valuation by a much smaller amount than in the case of bone.

On the other hand, average tankage is not as finely ground as one. Both should be much finer than they are in order to be ickly available.

The descriptions of the samples analyzed are as follows:

22424 and **22044** were made by Connecticut Fat Rendering and ertilizing Corp., New Haven. The first sample was drawn at e factory, the second sampled and sent by George Wilcox, haker Station.

22986. Self-Recommending Fertilizer, made by Valentine Bohl, Waterbury, and sampled at the factory.

22902. Made by New England Fertilizer Co., sampled and sent by S. T. Welden, Simsbury.

22856. Made by Springfield Rendering Co., sampled and sent by Somersville Mfg. Co., Somersville.

22658. Made by Buffalo Fertilizer Co., sampled from stock of S. L. Tuttle, Wallingford.

22457 and **22405.** Sold by The American Agricultural Chemical Co. The first sample was drawn from stock of Spencer Bros. and E. Halladay, Suffield, the other from stock of Andrew Ure, Highwood.

22811. Sold by Parmenter & Polsey Fertilizer Co. Sampled and sent by Pring Bros., Wallingford.

22901 and **22900.** Made by New Haven Rendering Co., both of them sampled and sent by S. D. Woodruff & Sons, Orange.

22489. Sold by C. M. Shay Fertilizer Co. Sampled from stock of Knowles-Lombard Co., Guilford.

22437 and **22537.** Sold by The Coe-Mortimer Co. The first was taken from stock of J. G. Schwink and the latter from stock of Connecticut School for Boys, both of Meriden.

22361. Sold by The Rogers Manufacturing Co. Sampled from stock of L. M. Benham, Highwood.

The manufacturers of the last four samples in the table are unknown. Three of them were taken from stock of S. D. Woodruff & Sons and **22346** from stock of Chas. R. Treat of Orange.

GUARANTIES.

Six of the samples of tankage had less of either nitrogen or phosphoric acid than was guaranteed, but in every case this deficiency was fully offset by a surplus, over guaranty, of the other ingredient.

Nos. 22385, 22386 and 22633 had no guaranty of phosphoric acid and contained from 0.6 to 1.1 per cent. less nitrogen than was guaranteed.

Nos. **22385** and **22386** are of questionable origin and valu
The percentage of phosphoric acid in them is very much low
than is found in garbage tankage, and the solubility of th
nitrogen, as estimated by the neutral permanganate method,
also lower. In seventeen other samples of tankage, 92.5 pe
cent. of the nitrogen was found to be soluble, but only 83.7 an
81.6 per cent., respectively, in these.

ANALYSES AND VALUATIONS OF SLAUGHTER HOUSE TANKAGE.

Station No.	Name of Manufacturer or Wholesale Dealer.	Mechanical Analysis. Coarser than 1-50 inch.	Mechanical Analysis. Finer than 1-50 inch.	Nitrogen found.	Phosphoric acid found.	Cost per ton.	Valuation per ton.	Percentage ...
22424	Conn. Fat Rendering and Fertilizing Corp., New Haven	80	20	6.79	12.75	$25.00	$28.28	*1
22986	Valentine Bohl, Waterbury	48	52	4.62	20.57	28.00	28.75	*
22902	New England Fertilizer Co.	64	36	5.78	15.61	28.00	28.19	*
22856	Springfield Rendering Co.	70	30	7.40	11.00	30.00	29.87	
22658	Buffalo Fertilizer Co.	48	52	7.41	7.19	30.00	29.29	
22457	American Agricultural Chemical Co.	46	54	6.00	13.62	30.50	28.95	
22811	Parmenter & Polsey Fertilizer Co.	62	38	5.74	13.28	29.00	26.72	[illegible]
22901	New Haven Rendering Co.	75	25	5.30	16.58	29.00	26.55	[illegible]
22489	C. M. Shay Fertilizer Co.	74	26	7.33	11.00	33 00	29.32	1
22900	New Haven Rendering Co.	77	23	4.88	17.27	29.00	25.57	1
22405	American Agricultural Chemical Co.	56	44	5.24	14.64	....	26.41	..
22437	Coe-Mortimer Co.	53	47	5.39	10.13	....	24.19	..
22537	Coe-Mortimer Co.	67	33	5.74	12 18	....	25 69	..
22044	Conn. Fat Rendering and Fertilizing Corp.	49	51	6.36	16.27	....	31.66	..
22361	Rogers Manufacturing Co.	49	51	6.70	12.95	....	30.62	..
22385	Unknown	28	72	5.62	2.29	....	21.32	...
22386	Unknown	29	71	5.52	2.49	....	21.05	...
22633	Unknown	44	56	6.02	16.63	....	31.14	...
22346	Unknown	53	47	6.77	12.73	....	30.39	...

* Valuation exceeds cost.

GARBAGE TANKAGE.

This is prepared from city garbage by extracting the grease and drying the residue. Its nitrogen is believed to be much less readily available than that of slaughter-house tankage.

22720. Made by American Reduction Co., Pittsburgh, Pa. Sampled from stock owned by F. W. Barker, Branford.

22383 and **22384.** Sampled from stock of S. D. Woodruff & Sons, Orange.

ANALYSES OF GARBAGE TANKAGE.

Station No.	22720	22383	22384
Percentage amounts of			
Nitrogen	2.07	2.45	2.51
Phosphoric acid	5.08	5.07	5.37
Water-soluble potash	0.82	0.97	0.96

The average nitrogen solubility of the seventeen slaughter-house tankages previously mentioned was 92.5; that of the three garbage tankages was 47.5, 48.0 and 51.1, respectively.

DRY GROUND FISH AND ACIDULATED FISH.

(ANALYSES ON PAGE 48.)

This is a by-product from the manufacture of fish oil, a process which removes from the fish little that is of value as a fertilizer.

The fresh fish are cooked by steam, pressed to remove the oil, and dried either in the air, or more commonly, in the large factories, by steam. The scrap is sometimes sprinkled with diluted oil of vitriol, to check putrefaction, whereby the bones are softened and to some extent dissolved. Twenty samples have been examined, seventeen of which are described in the table. Two samples, **22976** and **22977**, were sent as Bowker's Dry Fish by C. W. Beardsley of Milford for examination as to purity and freedom from chemicals. They contained respectively 8.88 and 8.54 per cent. of nitrogen and were pure dry fish scrap.

A sample of crude fish scrap, **21814**, sent by E. E. Burwell of New Haven, contained 4.32 per cent. of nitrogen and 4.57 per cent. of phosphoric acid.

Regarding the tabulated analyses, the samples **21986** and **22485**, made by the Niantic Menhaden Oil and Guano Co., contain less nitrogen than is guaranteed. The manufacturers stated that these were sold in 1908 and did not represent the goods which they were selling this year. Another sample, **23010**, made by the same company and put out in 1909, had a much higher percentage of nitrogen.

GUARANTIES.

With the exceptions above noted, all the samples fully met their guaranties as respects nitrogen. In a few cases the phosphoric acid found was not as much as guaranteed, but the money value of this deficiency was fully made up by the excess of nitrogen.

Percentage Composition and Valuation of Dry Fish.

Station No.	Manufacturer or Dealer.	Sampled by	Nitrogen. Found.	Nitrogen. Guaranteed.	Phosphoric acid. Water-soluble.	Phosphoric acid. Citrate-soluble.	Phosphoric acid. Citrate-insoluble.	Total phosphoric acid. Found.	Total phosphoric acid. Guaranteed.	Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
22579	Parmenter & Polsey Fertilizer Co.	James Price, Warehouse Point	8.90	7.5	0.88	8.47	1.28	10.63	11.0	$40.00	40.96	2.3*
22667	Olds and Whipple	R. M. Thompson, So. Manchester	9.46	8.6	0.82	5.25	1.09	7.16	6.0	40.00	40.73	1.8*
22310	Essex Fertilizer Co.	B. L. Root from stock of Spencer Bros., Suffield	9.11	7.5	0.48	8.41	1.98	10.87	11.0	42.00	41.63	0.9
22573‡	Wilcox Fertz. Works	Station agent from factory	8.24	7.8	2.15	3.65	0.40	6.20	5.0	36.50	35.75	2.1
22487	Sanderson Fertz. & Chem. Co.	Station agent at factory	8.68	8.3	1.04	6.84	1.33	9.21	6.0	40.00	39.13	2.2
22964	Essex Fertilizer Co.	Station agent from Spencer Bros., Suffield and W. K. Ackley, East Hartford	8.90	7.5	0.53	8.37	2.75	11.65	11.0	42.50	41.20	3.2
23010†	Niantic Menhaden Oil & Guano Co.	Station agent from Olds & Whipple, Hartford	8.52	8.2	0.41	4.95	1.38	6.74	6.0	38.00	36.73	3.5
22974	Wilcox Fertz. Works	Station agent from factory and M. E. Thompson, Ellington	8.80	8.5	0.65	4.49	1.27	6.41	6.0	39.75	37.61	5.7
22428	Rogers Mfg. Co.	C. C. Chapin, Thompsonville	8.13	8.2	1.76	3.64	0.70	6.10	8.0	38.00	35.13	8.2
22532	National Fertilizer Co.	Henry Davis, Thompsonville	8.17	8.2	0.62	6.83	1.25	8.70	....	40.00	36.83	8.6
22963	Bowker Fertilizer Co.	Station agent from A. D. Bridge's Sons, Hazardville and J. F. Ellwood, Greens Farms	8.39	8.2	0.64	5.93	1.36	7.93	....	40.50	37.08	9.2
22970	National Fertilizer Co.	Station agent from G. A. Williams, Silver Lane, J. A. Glasnapp, Cheshire, and J. M. Lasbury, Broad Brook	8.42	8.3	0.65	4.07	1.38	6.10	....	39.75	35.92	10.7
22486	Olds & Whipple	Station agent from dealer	6.69	6.0	0.69	9.79	3.59	14.07	12.0	38.00	34.26	10.9
22971‡	Niantic Menhaden Oil & Guano Co.	Station agent from F. H. Rolf, Guilford, and others	4.82	3.8	0.32	3.25	3.89	7.46	3.5	25.25	22.42	12.6
22483	American Agricultural Chemical Co.	Station agent from Spencer Bros. Suffield, and Edmund Halladay, Suffield	8.50	8.2	0.67	4.74	1.05	6.46	...	41.50	36.58	13.4
21986	Niantic Menhaden Oil & Guano Co.	Spencer Bros., Suffield	7.94	8.2	0.88	5.13	1.15	7.16	6.0	40.00	34.92	14.5
22485†	Niantic Menhaden Oil & Guano Co.	Station agent from Spencer Bros., Suffield, and F. S. Bidwell & Co., Windsor Locks	7.80	8.2	0.62	4.47	1.06	6.15	6.0	41.00	33.69	21.7

luation exceeds cost. † See note page 47. ‡ [illegible]

COST AND VALUATION.

The valuations in two cases exceed cost and in six other cases the average percentage difference is less than 7.0. The composition of dry fish is much more constant than that of tankage, the cost of nitrogen and phosphoric acid is somewhat lower, and there can be no question of its ready availability to crops.

MIXTURES OF DISSOLVED PHOSPHATE AND POTASH.

The use of the word "bone" or "animal bone" is misleading unless the brand contains real bone and has nitrogen, which is a necessary constituent of bone. No nitrogen is claimed in any of these fertilizers.

22969. Chittenden's Soluble Bone and Potash. Made by The National Fertilizer Co. Sampled from stock of H. A. Bugbee, Willimantic.

22985. Superphosphate with Potash. Made by the Sanderson Fertilizer and Chemical Co. Sampled from stock of G. W. Eaton, Plainville.

22967. Lister's Animal Bone and Potash. Made by Lister's Agricultural Chemical Works. Sampled from stock of D. H. Carrier & Son, Glastonbury.

ANALYSES.

Station No.	22969	22985	22967
Percentage amounts of			
Water-soluble phosphoric acid	8.72	6.86	8.77
Citrate-soluble phosphoric acid	2.72	1.33	2.08
Citrate-insoluble phosphoric acid	0.87	0.37	0.60
Total phosphoric acid	12.31	8.56	11.45
Water-soluble potash	2.74	5.30	2.22
Cost per ton	$25.00	24.00	25.00
Valuation per ton	$11.56	11.08	10.61
Percentage difference between cost and valuation	116.3	116.6	135.6

A mixture of 1,500 pounds of acid phosphate and 200 pounds of muriate of potash would contain as much plant food as these mixtures and would cost at the usual retail prices about $16.00.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included those mixed fertilizers containing nitrogen, phosphoric acid and, in most cases, potash, which are not designed by their manufacturers for use on any special crop.

"Special Manures" are noticed further on.

1. *Samples Drawn by the Station Agent.*

In the tables, pages 54 to 71, are given analyses of ninety-six samples arranged according to the percentage difference between cost and valuation.

Analyses requiring Special Notice.

A test sample of Woodruff's Home Mixture, **22387**, was analyzed March 22, 1909. The manufacturer states that finding the tankage used in this mixture was not as guaranteed, the formula was changed and **22613**, given on pages 54 and 55, shows the composition of the goods after this change. **22387** had the following composition: Nitrogen 3.03, "available" phosphoric acid 9.66, potash 7.89. The valuation was $25.38 per ton.

Boardman's Complete Fertilizer, **22509**, was found to contain less potash than guaranteed. At request of the manufacturer a second sample was drawn and analyzed. Both analyses appear on pages 54 and 55.

It was not possible to learn the price charged for the Connecticut Valley Orchard Co.'s Fertilizer, **22751**. Therefore no comparison of price and valuation can be made and it is entered in the table on pages 70 and 71.

GUARANTIES.

Of the ninety-six samples collected by the Station, four failed to meet their guaranties in two particulars and nineteen in a single particular—most commonly potash. In all cases, however, a deficiency of one ingredient was made good in money equivalent by other ingredients which exceeded the guaranty.

Cost and Valuation.

An effort is made to get a statement of cash retail price from each dealer from whom a sample is taken and these statements are in all cases submitted to the manufacturer for criticism. In general an average of the quoted prices forms the basis of comparison between cost and valuation. The price thus used is shown in the tables by full-faced type.

Valuation.

The method and meaning of valuation is explained on page 40.

The schedule of trade-values is given on page 41. The organic nitrogen in mixed fertilizers is reckoned at the price of nitrogen in raw material of the best quality, 19 cents per pound.

Citrate-insoluble phosphoric acid is rated at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

In most cases the valuation of the ingredients in superphosphates and specials falls considerably below the retail price of these goods. The difference between the two figures represents the manufacturer's necessary charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investments, bad debts and, finally, profits.

To obtain the Valuation of a Fertilizer, multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. The several products give the values per ton of the several ingredients and their sum is the total valuation per ton.

Percentage Difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer and furnishes the best means we have for expressing the *comparative* commercial (but not *agricultural*) value of the different brands.

This information helps the purchaser to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

The average cost per ton of the ninety-five nitrogenous superphosphates, of which the costs and valuations are given in the table, is $32.16, the average valuation $20.68, and the percentage difference 55.5.

The average composition and cost of nitrogenous superphosphates for the last six years have been as follows:

	Nitrogen.	Total Phosphoric Acid.	"Available" Phosphoric Acid.	Potash.	Cost per ton.	Percentage Difference.
1904.........	2.68	10.02	....	4.31	$31.01	50.1
1905.........	2.56	10.02	....	4.59	30.79	45.5
1906.........	2.50	9.99	....	4.66	31.00	47.6
1907.........	2.81	9.66	....	5.04	32.04	34.6
1908.........	2.67	9.63	8.22	4.68	32.28	40.2
1909.........	2.69	9.36	8.08	4.89	32.16	55.5

2. *Sampled by Purchasers and Others.*

On pages 70 and 71 are given sixteen analyses of nitrogenous superphosphates which were sent for analysis by interested persons. The station is not responsible for the sampling of these articles.

21981, a sample of Armour's All-Soluble, was drawn by our agent in June, 1908, examined in 1909 at request of the dealer, H. K. Brainard, Thompsonville, and contained nitrogen 2.96, phosphoric acid 9.61, and water-soluble potash 4.07 per cent.

Two samples, **22759** and **22760**, were supposed to represent two special mixtures made for J. I. Webb of Hamden. The buyer informed us later that he had found that the samples were not properly taken. They contained:

Station No.	22759	22760
Nitrogen	2.22	1.92
Total phosphoric acid	8.25	8.32
Water-soluble potash	2.71	2.58

The Selection and Purchase of Commercial Fertilizers.

The farmer must get into the way of studying the actual amount of plant food which he buys and uses, and its cost, and get out of the way of considering only the number of pounds of "phosphate" which he applies per acre and the cost per ton.

The beginning of saving is to drop the idea of using so many "pounds of phosphate" ("phosphate" meaning any mixed fertilizer which is at hand), and take up the idea of using so many pounds of nitrogen, phosphoric acid and potash in the cheapest and most concentrated form. Then the manufacturer will drop his practice of using swamp muck, phosphate dust and other fillers necessary to meet the call for "a $25.00 phosphate" and will search all the more diligently for high-grade goods.

The chief value of the tables of analyses given on pages 54 to 71 is to put the farmer in position to compare fertilizers in two ways: first, by the amounts of nitrogen, phosphoric acid and potash in them, and second, by the cost of these things in the different brands.

The limits imposed by statute on the size of this report forbid any extended discussion of this matter. The farmer can easily make his own "valuation" and his ***comparison of relative cost of actual plant food*** in any two fertilizers in the following way:

Let us assume that Smith's superphosphate sells for $34.00 and ontains, as shown by the tables of analyses, 3.35 per cent of itrogen, 8.04 per cent. of "available" phosphoric acid and 6.45 er cent. of potash as muriate.

Jones' superphosphate costs only $26.25 per ton and contains .33 per cent. of nitrogen, 6.98 per cent. of "available" phoshoric acid and 2.25 per cent. of potash.

Samples like these will be found in abundance in our reports. 'he question is, which is the cheaper source of plant food, the igher grade, selling at $34.00, or the lower grade, selling at a much lower price?

Multiplying the percentages by twenty will give the number of pounds of each ingredient in the ton. To compare the two we must figure what we get in each for the same money. Let us calculate on the amount purchasable for $30.00. This is done by "rule of three." The proportion for Smith's fertilizer will be:

$34 is to $30 as 67 (pounds of nitrogen in a ton) is to 59 (pounds purchasable for $30.00). The completed calculation shows that for $30.00 there can be bought:

	In Smith's Superphosphate.	In Jones' Superphosphate.
Pounds of nitrogen	59	30
" " phosphoric acid	142	159
" " potash	114	51

To get the amount of plant food purchasable for $30 in Smith's superphosphate the buyer pays freight on 1,760 pounds of fertilizer; while to get the smaller amounts purchasable for the same money in Jones' superphosphate he must pay freight on 2,250 pounds.

The buyer knows as much about the availability of nitrogen in one brand as he does about its availability in the other. The usefulness of the tables of analyses rests in part on the assumption that the manufacturing firms doing business year after year in this State are not using inferior forms of nitrogen. If a farmer knows of dishonest practices, or failures to meet their promises, on the part of any firm, he will, of course, exclude their goods from consideration.

Such a study and comparison as we have outlined above will not in all cases insure the choice of the very best fertilizer in the

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	
	Sampled by Station Agent:			
22613†	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	Manufacturer	$3
22612	Manchester's Formula	E. Manchester & Sons, Winsted	*W. J. Warner, Gilead	3
22509†	Boardman's Complete Fertilizer	F. E. Boardman, Route 1, Middletown	Manufacturer	3
22771†	Boardman's Complete Fertilizer	F. E. Boardman, Route 1, Middletown	Manufacturer	3
22958	Wilcox's H. G. Fish and Potash	Wilcox Fertilizer Co., Mystic	Manufacturer	2
			W. A. Howard, Woodstock	2
22610	Wilcox's Fish and Potash	Wilcox Fertilizer Co., Mystic	Manufacturer	-
			B. F. Pease, Greenfield Hill	2
22359	Clark's Special Mixture for General Crops	Everett B. Clark Seed Co., Milford	*Leonard M. Benham, Highwood	3
22846	Mapes' Top Dresser, Improved, Full Strength	The Mapes F. and P. G. Co., New York	Mapes' Branch, Hartford	53
			Wheeler Bros., Stonington	-
				55
22358	Clark's Special 10% Brand	Everett B. Clark Seed Co., Milford	*Leonard M. Benham, Highwood	34
22918	Market Garden Manure	Niantic Menhaden Oil and Guano Co., So. Lyme	F. H. Rolf, Guilford	38.
22601	Quinnipiac Market Garden Manure	Amer. Agrl. Chem. Co., New York	C. Buckingham, Southport	35
			*W. H. Burr, Westport	34
				34.
22821	Packers' Union Gardeners Complete Manure	Amer. Agrl. Chem Co., New York	F. M. Loomis, Granby	36.
			W. H. Billings, Somerville	35.
				35.5
22513	Mapes' Vegetable Manure, or Comp. Manure for Light Soils	The Mapes F. and P. Guano Co., New York	Mapes' Branch, Hartford	43.0
			J. P. Barstow & Co., Norwich	44.0
			Birdsey & Raven, Meriden	45.0
				44.0
22968	Mapes' Dissolved Bone	The Mapes F. and P. Guano Co., New York	Mapes' Branch, Hartford	33.0
			Wheeler Bros., Stonington	33.0
22482	"Swift-Sure" Superphosphate for General Use	M. L. Shoemaker & Co., Philadelphia, Pa.	F. A. Forbes, East Haven	32.0
			Spencer Bros., Suffield	36.0
			F. S. Bidwell & Co., Windsor Locks	36.0
				34.75

ANALYSES AND VALUATIONS.

	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
3	9.2	1.85	0.68	1.84	4.37	**3.3**	2.24	4.19	0.94	7.37	**8.0**	6.43	....	8.20	8.20	**8.0**
2	14.4	....	2.48	1.34	3.82	**3.5**	4.30	3.15	2.66	10.11	....	7.45	**8.0**	7.04	7.04	**7.5**
9	20.8	0.34	0.72	2.52	3.58	**3.3**	6.77	1.87	0.14	8.78	....	8.64	**7.0**	9.66	9.66	**10.0**
1	24.9	0.54	0.47	2.27	3.28	**3.3**	6.29	2.30	0.57	9.16	....	8.59	**7.0**	9.82	9.82	**10.0**
8	25.9	0.16	0.30	3.08	3.54	**3.3**	3.85	2.54	0.72	7.11	**6.0**	6.39	**5.0**	5.46	5.46	**4.0**
0	26.6	....	0.42	2.76	3.18	**2.5**	2.69	3.25	1.74	7.68	**6.0**	5.94	**5.0**	4.09	4.09	**3.0**
9	*29.3*	....	*2.02*	*1.18*	*3.20*	**3.3**	*6.03*	*2.72*	*1.48*	*10.23*	....	8.75	**8.0**	*6.26*	*6.26*	**7.0**
5	30.0	4.92	4.16	0.61	9.69	**9.9**	0.22	7.30	1.18	8.70	**8.0**	7.52	....	0.85	3.97	**4.0**
8	30.3	1.15	1.33	0.72	3.20	**3.3**	4.32	1.95	1.21	7.48	....	6.27	**6.0**	11.43	11.43	**10.0**
3	35.0	1.36	0.44	2.48	4.28	**4.1**	5.26	2.38	0.50	8.14	**8.0**	7.64	**7.0**	0.58	6.75	**6.0**
1	37.1	....	1.52	1.73	3.25	**3.3**	7.08	1.68	0.96	9.72	**9.0**	8.76	**8.0**	7.31	7.31	**7.0**
1	38.1	....	0.74	2.03	2.77	**2.5**	5.67	1.30	1.04	8.01	**7.0**	6.97	**6.0**	0.76	9.72	**10.0**
1	38.3	2.27	1.99	0.99	5.25	**4.9**	1.07	6.96	0.90	8.93	**8.0**	8.03	**6.0**	0.85	7.83	**6.0**
1	39.4	....	0.43	2.82	3.25	**2.1**	4.44	10.33	1.78	16.55	....	14.77	**12.0**	....	....	....
	40.7	1.04	...	1.86	2.90	**2.9**	8.59	3.14	1.06	12.79	....	11.73	**9.0**	0.70	4.81	**4.5**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
	Sampled by Station Agent:			
22706	High Grade Manure	Buffalo Fertilizer Co., Buffalo, N. Y.	J. R. Reinhard & Sons, Cheshire	$38.0
			Seth Schofield, Stafford Springs	38.0
22797	A. A. C. Co.'s Complete Manure with 10% Potash	Amer. Agrl. Chem. Co., New York	D. L. Clark, Milford	37.0
			Peck Bros., Plainville	40.0
				38.5
22571	Sanderson's Formula A	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	35.0
			Morse & Landon, Guilford	34.0
			G. W. Eaton, Plainville	37.0
				35.2
22876	Darling's Blood, Bone and Potash	Amer. Agrl. Chem. Co., New York	Elmer Rose, Wallingford	40.0
22451	O. & W.'s Special Phosphate	Olds & Whipple, Hartford	Manufacturer	35.0
22776	Fish and Potash	The Rogers Mfg. Co., Rockfall	G. H. Sloan, Windsorville	29.0
			Manufacturer	30.0
			*W. H. Filley, Windsor	31.0
				30.0
22945	Swift's Lowell Superior Fertilizer	Swift's Lowell Fertilizer Co., Boston, Mass.	F. E. Weed & Co., New Canaan	42.0
			Edward White, Rockville	40.0
				41.0
22885	Bone, Blood and Potash	Armour Fertilizer Works, Baltimore, Md.	Farmers' Supply Co., Bridgeport	39.0
22895	Kelsey's Bone, Fish and Potash	Sanderson Fert. and Chem. Co., New Haven	Loomis Bros., Granby	29.0
22606	Chittenden's XXX Fish and Potash	National Fertilizer Co., New York	F. H. Rolf, Guilford	26.0
			G. D. Mosher, Milford	26.0
			J. & H. Woodford, Avon	28.0
				26.7
22757	Bone, Fish and Potash	Niantic Menhaden Oil and Guano Co., So. Lyme	J. P. Barstow & Co., Norwich	30.00
			F. S. Bidwell & Co., Windsor Locks	30.00
			J. O. Fox, Putnam	30.00
22888	Market Garden Special	Armour Fertilizer Works, Baltimore, Md.	O. H. Meeker, Danbury	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.	
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.	
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.
706	41.3	0.17	2.53	0.65	3.35	3.3	4.91	2.79	1.15	8.85	9.0	7.70	7.0	10.49	10.49
797	42.9	0.20	1.90	1.40	3.50	3.3	5.59	1.30	0.91	7.80	7.0	6.89	6.0	10.31	10.31
571	42.9	0.78	0.20	2.45	3.43	3.3	5.38	2.44	0.74	8.56	9.0	7.82	6.0	6.81	6.81
876	43.3	0.28	1.92	2.08	4.28	4.1	6.00	1.80	0.92	8.72	8.0	7.80	7.0	7.21	7.21
451	44.4	----	0.49	3.90	4.39	4.1	0.24	4.60	1.01	5.85	----	4.84	4.0	0.70	4.04
776	44.7	1.10	0.22	2.04	3.36	3.3	2.43	2.92	2.38	7.73	6.0	5.35	4.0	4.32	4.32
945	44.8	0.79	0.12	2.82	3.73	3.7	4.30	2.77	0.67	7.74	8.0	7.07	7.0	10.51	10.51
885	45.2	1.52	1.24	1.22	3.98	4.1	6.37	1.73	1.29	9.39	8.5	8.10	8.0	7.23	7.23
895	45.8	----	0.36	2.40	2.76	2.5	2.32	2.58	1.25	6.15	5.0	4.90	4.0	3.50	5.90
606	45.9	----	0.90	1.80	2.70	2.5	4.64	1.37	1.38	7.39	6.0	6.01	5.0	3.79	3.79
757	46.3	----	0.54	2.56	3.10	2.5	2.32	3.29	1.73	7.34	6.0	5.61	5.0	0.53	4.17
388	46.6	1.05	0.85	1.40	3.30	3.3	8.10	0.79	0.09	8.98	8.5	8.89	8.0	6.83	6.83

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
	Sampled by Station Agent:			
22449	North Western Universal Fertilizer	Am'n Agric'l Chem. Co., New York	Spencer Bros., Suffield	$34.
			Edmund Halladay,"	32.
			F. S. Bidwell & Co., Windsor Locks	34.
				33.
22750	Quinnipiac Phosphate	Am'n Agric'l Chem. Co., New York	Gault Bros., Westport	30.
			G. M. Williams Co., New London	32.
			C. C. Pierce, Putnam	32.
				31.
22753	New England Superphosphate	New England Fertilizer Co., Boston, Mass	Gideon Brown, South Manchester	33.
			B. F. Eddy, East Woodstock	34.
			T. E. Green, Plainfield	30.
				32.
22758	Plymouth Rock Brand	Parmenter & Polsey Fertilizer Co., Boston, Mass	T. J. Pring, Wallingford	**32.**
			Arthur Williams, South Woodstock	..
			F. B. Newton, Plainville	32.
22557	Ammoniated Bone with Potash	Armour Fertilizer Works, Baltimore, Md.	E. A. Buck & Co., Willimantic	29.
			Farmers Supply Co., Bridgeport	29.
			O. H. Meeker, Danbury	28
				28.
22555	Church's Fish and Potash	Am'n Agric'l Chem. Co., New York	S. B. Potter, Norwich	28.
			A. H. Cashen, Meriden	26.
			Wilson & Burr, Middletown	28.
				27.
22839	E. F. Coe's Red Brand Excelsior Guano	Coe-Mortimer Co., New York	L. A. Gowdy, Hazardville	38.
			R. H. Morgan, West Cheshire	38.
				38.
22922	North Western 10% Manure	Am'n Agric'l Chem. Co., New York	*S. A. Flight, Highwood	**42.**
22800	Bradley's Farmers New Method Fertilizer	Am'n Agric'l Chem. Co., New York	Wilson & Burr, Middletown	30.
			F. M. Cole, Putnam	29.
				29.
22556	All Soluble	Armour Fertilizer Works, Baltimore, Md.	Lightbourn & Pond Co., New Haven	**33.**
			E. A. Buck & Co., Willimantic	33.
			O. H. Meeker, Danbury	33.

* Purchaser.

ANALYSES AND VALUATIONS—*Continued.*

Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
	As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
				Found.	Guaranteed				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
56.3	0.24	1.02	1.30	2.56	**2.5**	6.86	2.33	1.04	10.23	**9.0**	9.19	**8.0**	5.34	5.34	**4.0**
56.4	0.49	0.72	1.45	2.66	**2.5**	7.82	2.34	1.66	11.82	**11.0**	10.36	**9.0**	2.16	2.16	**2.0**
57.3	....	0.12	2.48	2.60	**2.5**	4.55	3.98	2.11	10.64	**10.0**	8.53	**8.0**	4.00	4.00	**4.0**
58.0	....	0.14	2.40	2.54	**2.5**	6.43	1.98	0.93	9.34	**9.0**	8.41	**8.0**	4.41	4.41	**4.0**
58.1	0.87	0.31	1.53	2.71	**2.5**	5.28	2.49	0.99	8.76	**8.5**	7.77	**6.0**	2.46	2.46	**2.0**
58.2	0.28	0.24	1.78	2.30	**2.1**	5.37	2.63	1.53	9.53	**7.5**	8.00	**6.0**	2.33	2.33	**2.0**
58.4	0.19	1.04	1.83	3.06	**3.3**	6.12	1.95	0.68	8.75	**9.0**	8.07	**8.0**	7.63	7.63	**7.0**
58.7	....	1.63	1.75	3.38	**3.3**	5.11	1.91	0.95	7.97	**7.0**	7.02	**6.0**	9.96	9.96	**10.0**
58.9	0.63	0.17	1.43	2.23	**1.7**	6.56	2.53	1.85	10.94	**10.0**	9.09	**8.0**	3.20	3.20	**3.0**
59.9	0.90	0.60	1.50	3.00	**2.9**	6.79	1.19	0.32	8.30	**8.5**	7.98	**8.0**	4.16	4.16	**4.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22681	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., New York	W. T. McKenzie, Yalesville	$37.00	$23.13
			J. Frank Elwood, Greens Farms	36.00	
			Hitchcock Hardware Co., Watertown	38.00	
22877	Darling's Farm Favorite	Am'n Agric'l Chem. Co., New York	Elmer Rose, Wallingford	30.00	18.71
22515	Top Dresser, Improved, Half Strength	The Mapes F. and P. Guano Co., New York	Mapes' Branch, Hartford	34.00	21.46
			F. S. Bidwell & Co., Windsor Locks	35.00	
				34.50	
22480	Bowker's Fisherman's Brand, Fish and Potash	Bowker Fertilizer Co., New York	W. T. McKenzie, Yalesville	29.00	17.81
			A. D. Bridge's Sons, Hazardville	30.00	
			J. Frank Elwood, Greens Farms	27.00	
				28.75	
22820	Baker's A. A. Ammoniated Superphosphate	Am'n Agric'l Chem. Co., New York	Arthur Manning, So. Manchester	32.00	19.71
			F. J. Hartz, South Manchester	32.00	
22607	Hubbard's New Market Garden Phosphate	Rogers & Hubbard Co., Middletown	E. L. Oviatt, Milford	36.00	22.57
			H. W. Andrews, Wallingford	34.00	
			F. S. Platt Co., New Haven	40.00	
				36.75	
22650	Farmers' Choice	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	24.00	15.92
			Manchester Elev. Co., Manchester	29.00	
			Seth Schofield, Stafford Springs	26.00	
				26.25	
22919	North Western Superphosphate	Am'n Agric'l Chem. Co., New York	G. W. Eaton, Bristol	33.00	20.00
22561	Essex XXX Fish and Potash	Essex Fertilizer Co., Boston, Mass.	W. K. Ackley, East Hartford	32.00	18.48
			Spencer Bros., Suffield	32.00	
			F. C. Benjamin & Co., Danbury	28.00	
				30.75	
22936	Sanderson's Special with 10% Potash	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	37.00	22.23
			G. W. Eaton, Plainville	37.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22681	60.0	....	1.00	1.42	2.42	2.5	5.20	2.42	1.16	8.78	7.0	7.62	6.0	9.44	9.44	10.
22877	60.3	0.10	0.76	1.41	2.27	2.1	6.54	2.43	1.33	10.30	9.0	8.97	8.0	3.50	3.50	3.
22515	60.8	2.83	1.69	0.38	4.90	4.9	0.72	3.02	0.67	4.41	4.0	3.74	....	0.19	2.00	2.
22480	61.4	0.36	0.45	1.80	2.61	2.5	3.07	2.37	1.20	6.64	5.0	5.44	4.0	4.29	4.29	4.
22820	62.4	0.85	0.16	1.57	2.58	2.5	6.98	2.89	2.07	11.94	11.0	9.87	9.0	2.30	2.30	2.
22607	62.8	0.86	0.06	1.20	2.12	2.0	4.32	3.35	0.29	7.96	7.0	7.67	6.0	10.64	10.64	10.
22650	64.9	....	0.29	0.85	1.14	0.8	4.89	4.55	1.60	11.04	9.0	9.44	8.0	4.88	4.88	5.
22919	65.0	0.18	0.46	2.04	2.68	2.5	4.82	4.92	2.17	11.91	10.0	9.74	9.0	2.27	2.27	2.
22561	66.4	....	0.04	2.24	2.28	2.0	6.05	2.67	1.13	9.85	9.0	8.72	8.0	3.14	3.14	3.
22936	66.4	0.64	0.22	2.00	2.86	2.5	3.84	2.13	0.43	6.40	8.0	5.97	5.0	8.28	8.28	10.

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22649	Fish Guano	Buffalo Fertilizer Co., Buffalo, N. Y.	J. & H. Woodford, Avon	$25.00	$14.99
			Manchester Elev. Co., Manchester	25.00	
			Seth Schofield, Stafford Springs	25.00	
22444	Eldredge's Fish and Potash	(Made for) T. H. Eldredge, Norwich	T. H. Eldredge, Norwich	30.00	17.95
22913	Chittenden's Market Garden Fertilizer	National Fertilizer Co., New York	Greenwich Hard. Co., Greenwich	38.00	21.54
			L. O. Pomeroy, Suffield	34.00	
				36.00	
22574	Swift's Lowell Animal Brand	Swift's Lowell Fertilizer Co., Boston, Mass.	Spencer Bros., Suffield	34.00	20.78
			T. H. Eldredge, Norwich	36.00	
			Southington Lumber Co., Southington	34.00	
				34.75	
22896	Lister's Ammoniated Dissolved Bone Phosphate	Lister's Agrl. Chem. Works, Newark, N. J.	G. T. Fowler, Branford	29.00	17.17
22570	Atlantic Coast Bone, Fish and Potash	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	26.00	15.36
			Morse & Landon, Guilford	24.50	
			G. W. Eaton, Plainville	29.00	
				26.00	
22448	North Western Fish, Bone and Potash	Amer. Agrl. Chem. Co., New York	Spencer Bros., Suffield	30.00	17.71
			Edmund Halladay, Suffield	30.00	
			F. S. Bidwell & Co., Windsor Locks	30.00	
22652	Genuine Peruvian Guano, Lobos Grade	Coe-Mortimer Co., New York	J. G. Schwink, Meriden	40.00	24.19
			R. H. Hall, East Hampton	42.00	
				41.00	
22615	Williams & Clark's Ammoniated Bone Superphosphate	Amer. Agrl. Chem. Co., New York	D. B. Wilson Co., Waterbury	35.00	19.99
			R. H. Hall, East Hampton	33.00	
				34.00	
22477	Bradley's XL Superphosphate	Amer. Agrl. Chem. Co., New York	H. K. Brainard, Thompsonville	34.00	19.83
			F. S. Bidwell & Co., Windsor Locks	34.00	
			Spencer Bros., Suffield	34.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid. *							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22649	66.8	....	0.20	1.00	1.20	0.8	5.62	4.45	2.34	12.41	10.0	10.07	9.0	0.93	2.09	2.
22444	67.1	....	0.32	2.12	2.44	1.7	2.57	3.17	1.63	7.37	6.0	5.74	5.0	4.55	4.55	4.
22913	67.1	0.71	0.82	1.09	2.62	2.5	6.81	2.23	1.30	10.34	9.0	9.04	8.0	5.58	5.58	6.
22574	67.2	....	0.04	2.58	2.62	2.5	6.85	2.37	0.69	9.91	10.0	9.22	8.0	4.02	4.02	4.
22896	68.9	....	0.20	2.00	2.20	2.1	6.06	2.88	1.23	10.17	9.0	8.94	8.0	1.80	1.80	1.
22570	69.3	0.12	0.20	1.54	1.86	1.7	1.71	3.27	0.74	5.72	6.0	4.98	4.0	5.26	5.26	4.
22448	69.4	....	0.28	2.26	2.54	2.5	3.31	1.96	0.67	5.94	5.0	5.27	4.0	4.57	4.57	4.
22652	69.5	1.58	0.64	0.78	3.00	2.9	4.37	7.15	2.51	14.03	14.0	11.52	8.0	1.59	4.57	4.8
22615	70.1	0.56	0.38	1.74	2.68	2.5	6.46	3.56	1.78	11.80	10.0	10.02	9.0	2.20	2.20	2.
22477	71.5	0.45	0.34	1.83	2.62	2.5	6.14	4.00	1.78	11.92	11.0	10.14	9.0	2.13	2.13	2.0

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22830	Armour's Fish and Potash Mixture	Armour Fertilizer Works, Baltimore	Brower & Malone, Norwalk	$34.00	
			S. V. Osborn, Branford	25.00	$14.56
22773	Chittenden's Ammoniated Bone Phosphate	National Fertilizer Co., New York	H. A. Bugbee, Willimantic	26.00	16.00
			J. M. Clark, Simsbury	29.00	
				27.50	
22925	Hubbard's Complete Phosphate	Rogers & Hubbard Co., Middletown	F. S. Platt Co., New Haven	30.00	17.39
			F. T. Blish Hard. Co., So. Manchester	30.00	
22889	Bowker's Hill and Drill Phosphate	Bowker Fertilizer Co., New York	A. D. Bridge's Sons, Hazardville	34.00	19.53
22955	Wilcox's Special Superphosphate	Wilcox Fertilizer Co., Mystic	Manufacturer	24.50	14.06
22891	Bowker's Bone and Wood Ash Fertilizer	Bowker Fertilizer Co., New York	Hitchcock Hard. Co., Watertown	30.00	16.72
22929	All Round Fertilizer	The Rogers Mfg. Co., Rockfall	H. L. Spear, Suffield	28.00	16.23
			Manufacturer	29.00	
			F. U. Wadhams, Torrington	31.00	
				29.25	
2747	Swift's Lowell Bone Fertilizer	Swift's Lowell Fertilizer Co., Boston, Mass.	T. H. Eldredge, Norwich	32.00	16.56
			Standard Feed Co., Bridgeport	30.00	
			J. D. Beasley, Ellington	28.00	
2710	H. G. Ammoniated Bone Superphosphate	Coe-Mortimer Co., New York	W. A. Burr, West Hartford	35.00	17.49
			J. P. Barstow & Co., Norwich	32.00	
			L. A. Gowdy, Hazardville	30.00	
2511	Complete Manure "A" Brand	The Mapes F. & P. Guano Co., New York	Mapes' Branch, Hartford	36.00	20.05
			F. S. Bidwell & Co., Windsor Locks	37.00	
			Birdsey & Raven, Meriden	38.00	
2842	Lister's Success Fertilizer	Lister's Agrl. Chem. Works, Newark, N. J.	D. C. Burnham, Moodus	30.00	15.61
			C. H. Sage, East Canaan	28.00	
				29.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Guaranteed.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Guaranteed.	So-called "Available." Found.	Guaranteed.	Potash. Found. As Muriate.	Total.	Guaranteed.
22830	71.7	....	0.06	1.78	1.84	**2.0**	4.94	1.74	1.32	8.00	**6.5**	6.68	**6.0**	2.23	2.23	**2.**[illegible]
22773	71.9	....	0.16	1.47	1.63	**1.7**	6.28	2.28	1.60	10.16	**9.0**	8.56	**8.0**	3.07	3.07	**2.**[illegible]
22925	72.5	0.24	0.03	1.32	1.59	**1.5**	4.79	3.95	0.28	9.02	**8.0**	8.74	**7.0**	5.61	5.61	**5.**[illegible]
22889	74.1	....	1.17	1.53	2.70	**2.5**	6.11	3.03	2.02	11.16	**10.0**	9.14	**9.0**	2.26	2.26	**2.**[illegible]
22955	74.3	0.16	0.06	1.04	1.26	**1.0**	3.09	5.48	2.34	10.91	**9.0**	8.57	**8.0**	2.51	2.51	**1.**[illegible]
22891	79.4	0.11	0.20	1.69	2.00	**1.7**	0.87	5.63	3.30	9.80	**8.0**	6.50	**6.0**	3.88	3.88	**2.**[illegible]
22929	80.2	0.73	0.30	0.77	1.80	**1.7**	6.63	2.39	0.88	9.90	**10.0**	9.02	**8.0**	3.00	3.00	**2.**[illegible]
22747	81.2	....	0.05	1.73	1.78	**1.7**	5.53	3.17	1.14	9.84	**9.0**	8.70	**8.0**	3.20	3.20	**3.**[illegible]
22710	83.0	0.24	0.30	1.60	2.14	**1.9**	5.77	2.08	0.64	8.49	**9.0**	7.85	**8.0**	3.84	3.84	**3.**[illegible]
22511	84.5	1.57	0.46	0.65	2.68	**2.5**	1.20	8.70	2.64	12.54	**12.0**	9.90	**10.0**	3.21	3.21	**2.**[illegible]
22842	85.8	0.14	0.22	1.14	1.50	**1.2**	7.16	2.68	1.24	11.08	**10.0**	9.84	**9.0**	2.31	2.31	**2.**[illegible]

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22709	E. F. Coe's Gold Brand Excelsior Guano	Coe-Mortimer Co., New York	J. G. Schwink, Meriden	......	$20.44
			W. A. Burr, W. Hartford	$40.00	
			L. A. Gowdy, Hazardville	36.00	
				38.00	
22880	Quinnipiac Climax Phosphate	Amer. Agrl. Chem. Co., New York	J. P. Lathrop, Plainfield	**28.00**	14.81
22804	Great Eastern General Fertilizer	Amer. Agrl. Chem. Co., New York	R. H. Hall, East Hampton	29.00	14.85
			T. E. Green, Plainfield	28.00	
				28.50	
22646	Packer's Union Universal Fertilizer	Amer. Agrl. Chem. Co., New York	G. W. Eaton, Bristol	30.00	15.04
			F. L. Mackey, Ellington	28.00	
			G. A. Forsyth, Waterford	**29.00**	
22445	Eldredge's Special Superphosphate	(Made for) T. H. Eldredge, Norwich	T. H. Eldredge, Norwich	**28.00**	14.12
22619	Bowker's Gloucester Fish and Potash	Bowker Fertilizer Co., New York	Lightbourn & Pond Co., New Haven	**25.00**	12.47
			Prentice Store, Turnerville	25.00	
22608	Swift's Lowell Empress Brand	Swift's Lowell Fertilizer Co., Boston, Mass.	F. E. Weed & Co., New Canaan	29.00	14.20
			Southington Lumber Co., Southington	28.00	
				28.50	
22882	Read's Standard Superphosphate	Amer. Agrl. Chem. Co., New York	C. W. Fulton, West Hartford	**30.00**	14.68
22799	Bradley's Eclipse Phosphate	Amer. Agrl. Chem. Co., New York	Phineas Platt, Milford	30.00	13.69
			F. M. Cole, Putnam	28.00	
				29.00	
22602	Berkshire Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	F. C. Benjamin Co., Danbury	28.00	13.38
			Hotchkiss & Templeton, Waterbury	30.00	
				29.00	
22560	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., New York	W. T. McKenzie, Yalesville	29.00	13.44
			E. W. Hubbell Co., Saugatuck	29.00	
			East Berlin Mill Co..		

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
22709	85.9	0.16	0.92	1.32	2.40	**2.5**	6.41	1.55	1.03	8.99	**9.0**	7.96	**8.0**	6.04	6.04	**6.0**
22880	89.1	0.10	0.18	1.18	1.46	**1.0**	4.93	3.59	2.61	11.13	**10.0**	8.52	**8.0**	2.24	2.24	**2.0**
22804	92.0	0.13	0.10	0.90	1.13	**0.8**	5.55	2.91	2.09	10.55	**9.0**	8.46	**8.0**	3.93	3.93	**4.0**
22646	92.8	0.13	0.14	0.87	1.14	**0.8**	5.96	2.48	2.01	10.45	**9.0**	8.44	**8.0**	4.13	4.13	**4.0**
22445	98.3	....	0.12	1.06	1.18	**1.0**	4.03	4.84	2.26	11.13	**10.0**	8.87	**8.0**	2.55	2.55	**2.0**
22619	100.5	....	0.20	0.95	1.15	**0.8**	4.70	4.02	1.62	10.34	**9.0**	8.72	**8.0**	1.13	1.13	**1.0**
22608	100.7	....	0.08	1.42	1.50	**1.2**	5.86	2.33	0.78	8.97	**8.0**	8.19	**7.0**	2.24	2.24	**2.0**
22882	104.4	0.10	0.14	0.86	1.10	**0.8**	6.64	1.95	1.52	10.11	**9.0**	8.59	**8.0**	3.89	3.89	**4.0**
22799	111.8	....	0.12	1.12	1.24	**1.0**	5.56	2.77	2.20	10.53	**9.0**	8.33	**8.0**	2.06	2.06	**2.0**
22602	116.7	0.10	0.20	0.92	1.22	**0.8**	6.38	2.26	0.06	8.70	**9.0**	8.64	**8.0**	2.55	2.55	**2.0**
22560	117.7	0.13	0.20	0.67	1.00	**0.8**	6.80	2.45	1.16	10.41	**10.0**	9.25	**9.0**	2.54	2.54	**2.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22600	Bradley's Niagara Phosphate	Am'n Agric'l Chem. Co., New York	Phineas Platt, Milford	$28.00	$12.19
			Wilson & Burr, Middletown	28.00	
22878	Darling's General Fertilizer	Am'n Agric'l Chem. Co., New York	E. L. Oviatt, Milford	34.00	14.70
22912	Chittenden's Universal Phosphate	National Fertilizer Co., New York	Greenwich Hard. Co., Greenwich	28.00	11.67
22751	Complete High Grade *Fertilizer*	Made for Conn. Valley *Orchard Co.*	Conn. Valley Orchard Co.	†	20.16
	Sampled by purchasers and others:		*Sent by*		
23342	Special Mixture No. 2	Wilcox Fertilizer Co., Mystic	R. C. Wilcox & Sons, Guilford	35.00	32.07
22874	Special Mixture	Sanderson Fert. & Chem. Co., New Haven	James I. Webb, New Haven	29.50	25.66
22871	Special Mixture	Sanderson Fert. & Chem. Co., New Haven	James I. Webb, New Haven	29.50	....
22780	Our Brand	Berkshire Fertilizer Co., Bridgeport	C. R. Burr & Co., Manchester	34.00	29.44
23341	Special Mixture No. 1	Wilcox Fertilizer Co., Mystic	R. C. Wilcox & Sons, Guilford	36.00	30.89
22779	Our Brand	Olds & Whipple, Hartford	C. R. Burr & Co., Manchester	34.00	28.34
22921	Our Brand	Olds & Whipple, Hartford	C. R. Burr & Co., Manchester	....	....
22564	Special Mixture	Sanderson Fert. & Chem. Co., New Haven	James I. Webb, New Haven	35.00	28.52
22429	H. G. Complete Fertilizer	Conn. Valley Orchard Co., Berlin	C. A. Parmalee, Deep River	28.00	22.04
22655	H. G. Fertilizer	Conn. Valley Orchard Co., Berlin	C. A. Parmalee, Deep River	28.00	21.78
22622	Peruvian Guano, Lobos Grade	Coe-Mortimer Co., New York	O. E. Pitcher, R. D. 2, Suffield	33.50	25.22
23353	Fish and Potash	Wilcox Fertilizer Co., Mystic	B. E. Shepard, Branford	26.00	19.11
22975	Formula "A" with 10% Sulphate of Potash	Sanderson Fert. & Chem. Co., New Haven	O. G. Beard, Shelton	26.00	24.02
22960	James's Bone Phosphate	Ernest L. James, Warrenville	Manufacturer	30.00	19.79
22795	Formula "A" with 10% Sulphate of Potash	Sanderson Fert. & Chem. Co., New Haven	O. G. Beard, Shelton	36.00	23.38
22782	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	W. J. Andrews, Cheshire	....	....

Analyses and Valuations—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22600	129.7	0.16	0.20	0.82	1.18	**0.8**	4.56	3.57	1.63	9.76	**8.0**	8.13	**7.0**	1.25	1.25	[illegible]
22878	131.3	0.08	0.20	1.25	1.53	**1.2**	4.33	3.07	1.64	9.04	**7.0**	7.40	**6.0**	3.22	3.22	[illegible]
22912	139.9	----	0.10	0.86	0.96	**0.8**	4.63	4.11	1.32	10.06	**10.0**	8.74	**8.0**	1.12	1.12	[illegible]
22751	----	----	0.12	2.28	2.40	**2.4**	7.58	2.19	0.46	10.23	**11.0**	9.77	**9.0**	3.90	3.90	[illegible]
23342	9.1	2.53	0.85	1.96	5.34	**4.8**	2.56	4.83	1.82	9.21	**8.7**	7.39	**5.5**	8.49	8.49	[illegible]
22874	15.0	2.22	0.10	1.82	4.14	---	3.04	2.49	1.16	6.69	----	5.53	----	7.58	7.58	--
22871	----	---	---	---	4.15	---	----	----	----	----	----	----	----	----	7.73	--
22780	15.5	0.24	1.50	2.34	4.08	**3.3**	7.73	1.30	0.32	9.35	----	9.03	**8.0**	8.75	8.75	[illegible]
23341	16.5	2.00	1.14	2.46	5.60	**5.5**	1.64	5.57	2.19	9.40	**9.0**	7.21	**5.0**	5.85	5.85	[illegible]
22779	20.0	0.16	0.40	3.54	4.10	**3.3**	0.36	7.78	1.69	9.83	----	8.14	**8.0**	7.74	7.74	[illegible]
22921	----	----	---	---	3.74	---	----	---	----	----	----	----	----	----	8.45	--
22564	22.7	0.61	11.0	2.83	3.55	**3.0**	1.78	2.20	0.43	4.41	----	3.98	----	14.42	14.42	8
22429	27.0	0.18	1.66	1.04	2.88	**2.5**	6.74	3.33	0.92	10.99	**10.0**	10.07	**9.0**	4.44	4.44	4
22655	28.6	----	0.12	2.48	2.60	**2.5**	7.49	1.80	0.45	9.74	**11.0**	9.29	**9.0**	5.32	5.32	4
22622	32.8	1.22	0.74	1.13	3.09	**2.9**	4.56	6.89	2.69	14.14	**14.0**	11.45	**8.0**	2.10	5.14	[illegible]
23353	36.1	----	0.34	2.48	2.82	**2.5**	3.41	2.62	0.88	6.91	**6.0**	6.03	**5.0**	4.26	4.26	[illegible]
22975	49.9	1.84	0.04	1.54	3.42	---	2.20	3.05	1.54	6.79	----	5.25	----	3.69	7.99	--
22960	51.6	0.12	---	1.97	2.09	**2.0**	2.33	6.30	3.80	12.43	**13.0**	8.63	**10.0**	4.83	4.83	**3**
22795	54.0	1.46	0.02	1.41	2.89	---	3.23	2.35	1.52	7.19	----	5.58	----	3.55	8.21	--
22782	----	----	---	---	3.18	**3.3**	----	----	---	10.36	**8.0**	----	----	----	8.96	**8**

Connecticut market, but it will go very far toward eliminating from his choice brands which the farmer cannot possibly use to advantage.

In the table below all the analyses on each manuscript page of the tables given on pages 54 to 71 have been averaged and the amounts of plant food purchasable for $30.00 in these averages have been calculated.

PURCHASABLE FOR THIRTY DOLLARS.

	Nitrogen, pounds.	Total phosphoric acid, pounds.	Available phosphoric acid, pounds.	Potash, pounds.
In the first 10 samples in the table	74	149	129	128
" " next 10 " " " "	66	175	156	125
" " " 11 " " " "	58	146	129	112
" " " 10 " " " "	49	162	143	102
" " " 9 " " " "	49	175	153	82
" " " 10 " " " "	47	164	142	93
" " " 10 " " " "	44	187	159	68
" " " 8 " " " "	37	195	166	71
" " " 11 " " " "	30	209	174	63
" " last 6 " " " "	25	298	171	43

This calculation, based not upon valuations, but on cost price and actual composition, shows that in general the fertilizers arranged according to their valuations as in the tables on pages 54 to 71, are in fact arranged in order of the relative economy of purchase of the plant food in them.

SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates containing potash, as are claimed by their manufacturers to be specially adapted to the needs of particular crops. Those which are claimed to contain potash in form of carbonate, tobacco specials, are separately considered on pages 104 and 105.

1. *Samples Drawn by Station Agent.*

One hundred and forty analyses are here reported of samples of this kind.

Analyses Requiring Special Notice.

Broad Brook Market Garden and Potato Special, **23007**, of which the analysis is given on pages 86 and 87, contained 3.32 per

cent. of nitrogen with a guaranty of 5.0 per cent. At request of the company, which was disappointed at the results of this test, a second sample, **23351**, sent by the Broad Brook Lumber & Coal Co., was examined and contained 4.13 per cent. of nitrogen, 8.21 of phosphoric acid and 6.80 of potash.

The C. M. Shay Fertilizer Co. stated that the analysis of their potato fertilizer, **22339**, pages 102 and 103, made on a sample sent by Thomas Griswold & Co., Wethersfield, was unsatisfactory and did not fairly represent their goods, being below guaranty in nitrogen. A sample, **22394**, drawn by the station agent from Griswold & Co.'s stock, gave practically the same figures as the other sample, as appears on pages 78 and 79. But a third sample, **23352**, pages 102 and 103, from another purchaser, had the guaranteed composition.

The Rogers & Hubbard Co., on account of the shortage of nitrogen and excess of phosphoric acid in their Hubbard's Oats and Top Dressing, **22562**, pages 80 and 81, asked that another sample should be drawn and tested. This was accordingly done and the analysis, **22852**, on the pages just noted, shows only a very slight shortage of nitrogen, while phosphoric acid and potash are far above guaranty.

The New England Fertilizer Co. stated that analysis **22917**, pages 86 and 87, did not fairly represent their goods and asked that another sample be drawn and tested. This was done with the results given on pages 82 and 83, **23364**.

Bowker's Lawn and Garden Dressing, **22890**, is sold chiefly in small packages for use on private lawns and small garden patches and cannot fairly be compared as to cost and valuation with fertilizers for farm use.

The sample analyzed contained:

Nitrogen as nitrates	0.66
Nitrogen as ammonia	1.76
Nitrogen, organic	0.41
Total nitrogen found	2.83
Total nitrogen guaranteed	3.00
Water-soluble potash found	5.69
Water-soluble potash guaranteed	5.00
Water-soluble phosphoric acid	2.61
Citrate-soluble phosphoric acid	3.26
Citrate-insoluble phosphoric acid	1.06
Total phosphoric acid found	6.93
Total phosphoric acid guaranteed	8.00

GUARANTIES.

Of the one hundred and forty samples examined, thirty-five, or one-quarter of the whole number, are below their guaranties by more than one-tenth per cent., in respect of one or more ingredients. Twelve are below in nitrogen alone, seven in phosphoric acid and twelve in potash, while four are below guaranty in respect of two ingredients.

In most cases the discrepancies are not large and a deficiency of one ingredient is balanced by an excess of some other ingredient.

Four of these special manures, however, are so deficient that they do not contain a full equivalent in money value of the quantities of plant food which they are claimed by their manufacturers to contain. The deficiencies range from one to two dollars per ton.

The deficient brands are:

Shay's Potato Manure, 22394, regarding which see note on page 73; Broad Brook Market and Potato Special, 23007, regarding which see note on pages 72 and 73; and Chittenden's H. G. Special Tobacco, 22911, Chittenden's Conn. Valley Tobacco Starter, 22916.

COST AND VALUATION.

The method of ascertaining the retail cash cost price of the special manures and of computing the valuation is the same as described on pages 50 and 51.

The average cost per ton of the one hundred and thirty-five special manures, the cost and valuation of which are given in the tables, was $35.24 per ton, the average valuation $23.54, and the percentage difference 49.7.

In 1908 the corresponding figures were: cost, $35.67; valuation, $26.02; percentage difference, 37.1.

PERCENTAGE COMPOSITION.

Year.	Nitrogen.	Total phosphoric acid.	"Available" phosphoric acid.	Potash.	Cost per ton.	Percentage difference.
1904	2.92	8.56	....	5.92	$33.93	45.0
1905	2.93	10.38	....	6.13	33.99	41.8
1906	2.99	9.98	....	5.92	34.28	44.6
1907	3.09	9.63	....	5.92	34.48	35.8
1908	3.12	9.49	7.75	6.42	35.67	37.1
1909	3.10	9.63	8.10	6.40	35.24	49.7

A comparison of these figures with those relating to nitrogenous superphosphates, on page 51, shows that as a rule special manures contain more nitrogen and potash than the other nitrogenous superphosphates with the same amount of phosphoric acid and sell at a somewhat higher price.

Even a superficial examination of the tables of analyses shows a very wide range of prices and of content of plant food in these one hundred and thirty-five brands.

There must, therefore, be a great difference between them in the relative economy of their purchase. This is brought out clearly by the following table, which shows how much plant food can be bought for the same money, $30.00, in several groups of these special manures.

Purchasable for Thirty Dollars.

	Nitrogen pounds.	Total phosphoric acid pounds.	"Available" phosphoric acid pounds.	Potash pounds.
In the first 10 samples in the table	68	184	140	137
" next 13 " " "	67	166	136	126
" " 14 " " "	60	150	121	131
" " 12 " " "	64	117	103	116
" " 12 " " "	51	163	137	124
" " 12 " " "	53	140	122	118
" " 9 " " "	50	158	139	102
" " 12 " " "	43	172	153	102
" " 9 " " "	48	176	153	72
" " 10 " " "	42	184	157	77
" " 12 " " "	39	186	159	93
" last 10 " " "	26	187	165	65

The table shows that among fertilizers made by reputable manufacturers and containing practically all that is guaranteed for them, there are some which supply more than twice as much nitrogen, twice as much potash and about the same amount of phosphoric acid as others for the same money.

Another point worthy of notice is that this table, compared with the table of analyses in which the several brands are arranged in order of their percentage difference, shows that as the percentage difference between cost and valuation increases, the probable economy of purchase decreases.

2. *Sampled by Purchasers and Others.*

In the table on pages 102 and 103 are five analyses of special manures, made on samples drawn by others than station agents.

"Fillers" and "Conditioners" in Mixed Fertilizers.

Fillers may have legitimate uses in commercial mixtures.

While their presence increases the freight charges on a given quantity of plant food, yet, when a certain percentage composi-

tion is guaranteed and expected, and particularly when the percentages of plant food are quite moderate, a makeweight of some kind may sometimes be desirable. To illustrate:—Imagine a brand with a guaranty of 2-10-2, made to answer a demand for a low-priced fertilizer. Such a fertilizer carries 40 lbs. each of nitrogen and potash and 200 of phosphoric acid in the ton. A mixture of 700 pounds of tankage, 80 of muriate of potash and 950 of acid phosphate will furnish those amounts, but falls short of a ton by 270 pounds. To make the goods conform exactly to the formula it may therefore be necessary and is certainly fair to add 270 pounds of some harmless makeweight. If materials carrying lower percentages of plant food than those above named were used in making the mixture, the addition of a filler would be unnecessary simply because the low grade materials themselves contained enough inert material to take the place of filler. The buyer of mixed goods having high percentages of plant food in them pays less freight for it than the one who gets those fertilizers which carry less plant food to the ton with a filler. For example: The man who buys potash salts of the highest grade pays perhaps $2.00 in freight on 1,000 pounds of actual potash. If he calls for a 25 per cent. potash salt he can get it, but he pays the same freight, $2.00, on 500 pounds of actual potash.

Another common use of inert material is to keep certain mixtures dry and in good "condition" so that they can be stored for the necessary length of time without caking in the bags and can be spread with a machine without clogging it. Mixtures made largely or exclusively of chemicals, like nitrates, potash salts and acid phosphate, are almost certain to cake before they can be shipped, sold and used. Where dry animal or vegetable matter, like cotton seed meal, tankage, or dry bone dust is used with them, this caking is hindered or prevented and these materials also furnish plant food. Other materials, having little or no fertilizing value, can accomplish the same thing and the amount required is relatively small. Finely ground phosphate rock or phosphatic guano, dry, fine, garbage tankage, of which analyses have been given on pages 34 and 37, and dried peat are also used. The last-named material is a powerful absorbent, and it is claimed that one or two hundred pounds of peat per ton will keep the most troublesome mixtures in fine "condition" for many months,

while a larger addition makes them too light and bulky to admit of its use.

It is commonly known that large quantities of fine dry peat are sold for the above purpose.

The objections to its use, on the part of the chemist, are that peat contains from 2½ to over 3 per cent. of nitrogen, that this nitrogen is agriculturally inert as compared with the forms for which eighteen or twenty cents per pound are charged, that it has not been possible to distinguish in a mixed fertilizer between nitrogen in this form and nitrogen in more quickly available forms and so, in consequence, such nitrogen appears in the analyses and valuations on a par with more valuable organic forms.

Nineteen of the samples analyzed this year gave reactions which indicated the presence of decayed vegetable matter or peat. In some cases the manufacturers have stated the amount used, which was in no case higher than 312 pounds to the ton of peat containing 2.7 per cent of nitrogen. This means 8.4 pounds of peat nitrogen per ton which, though known to be comparatively inert, is given the same value as the nitrogen of cotton seed meal and dried blood.

In all these cases the solubility of the organic nitrogen has been determined by the neutral permanganate method, as modified by Mr. Street and which need not be here described as it will be given in full in a technical journal. It is sufficient to say here that the organic nitrogen in such raw materials as are generally regarded as being quickly available and in dry mixtures of these materials with acid phosphate and muriate of potash, has when tested by this method a solubility of at least 90 per cent. The nitrogen of peat and of garbage tankage has a solubility of from 40 to 60 per cent.

The nitrogen of the samples from the Connecticut market which contained peat had solubilities ranging from 89.3 to 54.7. In general the larger the proportion of peat nitrogen to total organic nitrogen, the lower the solubility. It is of course quite possible that in some cases the low solubility of the organic nitrogen was due to garbage tankage or other low-grade forms.

It will be necessary hereafter to test the solubility of organic nitrogen in all mixed fertilizers and call attention to those brands containing nitrogen which is not so soluble as that of the standard "ammoniates."

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
	Sampled by Station Agent:			
22568	Potato Manure	L. T. Frisbie Co., New Haven	L. T. Frisbie, Hartford	$34.
22932	H. G. Soluble Tobacco Manure	Rogers Mfg. Co., Rockfall	Seth Alden, Thompsonville	43.
			L. A. Kent, Suffield	45.
			Herman Ude, Suffield	45.
				44.
22394*	Shay's Potato Manure	C. M. Shay Fertilizer Co., Groton	Thos. Griswold & Co.,† So. Wethersfield	30.
22931	Grass and Grain	Rogers Mfg. Co., Rockfall	Thos. Holt, Southington	41.
			G. H. Sloan, Windsorville	41.
22452	Grass Fertilizer	Olds & Whipple, Hartford	Manufacturer	34.
22938	Grass and Lawn Fertilizer	C. M. Shay Fertilizer Co., Groton	J. P. Barstow & Co., Norwich	38.
			G. M. Williams Co., New London	33.
				35.
22746	H. G. Soluble Tobacco and Potato	Rogers Mfg. Co., Rockfall	Thos. Holt, Southington	39.
			E. T. Hulburt, Somers	40.
			G. H. Sloan, Windsorville	40.
				39.7
22775	Oats and Top Dressing	Rogers Mfg. Co., Rockfall	Thos. Holt, Southington	45.
			Manufacturer	46.
			M. F. Tyler, Plainville	46.
				45.7
22934	H. G. Tobacco Grower	Rogers Mfg. Co., Rockfall	Jos. Greggs, Suffield	37.
			Manufacturer	39.
				38.
22685	Hubbard's Soluble Tobacco Manure	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	47.
			R. H. Hall, East Hampton	47.
22690	Potato, Onion and Vegetable	Wilcox Fertilizer Co., Mystic	Knowles, Lombard Co., Guilford	34.
			B. F. Pease,† Greenfield Hill	35.
				34.5
22567	Corn and Grain Fertilizer	L. T. Frisbie Co., New Haven	E. Rogers,† Southington	29.

* See notes pages 73 and 74. † Purchaser.

Analyses and Valuations.

…ation No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
68	8.1	1.82	...	1.56	3.38	**2.5**	0.34	14.24	5.12	19.70	**8.0**	14.58	**5.0**	8.48	8.48	**6.0**
32	18.9	1.24	0.68	3.23	5.15	**5.0**	1.44	7.43	2.66	11.53	**8.0**	8.87	**6.0**	0.94	11.49	**11.0**
94	22.2	0.43	0.17	2.89	3.49	**4.0**	2.64	4.76	0.99	8.39	**8.0**	7.40	....	6.74	6.74	**6.0**
31	22.6	0.27	0.04	2.89	3.20	**3.0**	0.08	11.37	7.33	18.78	**16.0**	11.45	....	12.33	12.33	**12.5**
52	23.4	0.10	0.15	3.87	4.12	**3.3**	0.05	6.63	2.34	9.02	....	6.68	**6.0**	7.51	7.51	**6.0**
38	24.5	0.85	0.26	3.33	4.44	**4.0**	3.28	5.08	1.52	9.88	**10.0**	8.36	....	6.33	6.33	**6.0**
46	25.2	0.74	0.56	2.80	4.10	**3.5**	3.45	5.69	2.32	11.46	**9.0**	9.14	**7.0**	0.78	9.23	**8.8**
75	26.5	3.36	1.08	1.96	6.40	**5.3**	4.58	4.30	1.05	9.93	**9.0**	8.88	**7.0**	8.09	8.09	**7.5**
34	26.9	1.47	0.38	3.15	5.00	**5.0**	2.17	3.89	1.19	7.25	**5.0**	6.06	**4.0**	0.49	6.97	**6.0**
85	27.3	2.16	0.42	2.32	4.90	**5.0**	0.67	8.86	3.20	12.73	**10.0**	9.53	**7.0**	1.40	11.72	**10.0**
90	27.4	1.08	0.66	1.92	3.66	**3.3**	6.34	2.70	0.93	9.97	**8.0**	9.04	**7.0**	4.98	7.40	**6.0**
67	27.6	....	0.02	2.41	2.43	**1.6**	0.36	12.45	5.18	17.99	**8.0**	12.81	**5.0**	2.83	2.83	**3.0**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	
	Sampled by Station Agent:				
22563	Swift-Sure Superphosphate for Potatoes	M. L. Shoemaker & Co., Philadelphia	F. A. Forbes, East Haven	$32.50	$2
			F. H. Rolf, Guilford	36.00	
				34.25	
22833	Berkshire Tobacco Special	Berkshire Fertilizer Co., Bridgeport	Manufacturer	34.00	
			B. O. Higley, Canton	**34.00**	2
22450	O. & W.'s H. G. Potato Manure	Olds & Whipple, Hartford	Manufacturer	**37.00**	2
22772	Mapes' Seeding Down	Mapes F. & P. G. Co., New York City	Mapes' Branch, Hartford	**42.00**	3
22687	Top Dressing Grass and Grain	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	38.00	2
			Morse & Landon, Guilford	35.00	
			R. H. Hall, East Hampton	38.00	
				37.00	
22957	Wilcox's Grass Fertilizer	Wilcox Fertilizer Co., Mystic	Manufacturer	36.00	2
			M. E. Thompson, Ellington	34.00	
				35.00	
22892	Tobacco Producer	Buffalo Fertilizer Co., Buffalo, N. Y.	G. B. Adams, Suffield	**37.00**	2
22573	Shay's Corn Fertilizer	C. M. Shay Fertilizer Co., Groton	J. P. Barstow & Co., Norwich	29.00	2
			Knowles, Lombard Co., Guilford	30.00	
				29.50	
22562*	Hubbard's Oats and Top Dressing	Rogers & Hubbard Co., Middletown	N. H. Sherwood, Southport	55.00	4
			John Hoffman,† Cromwell	57.00	
			H. W. Andrews, Wallingford	55.00	
				55.75	
22688	Wheeler's Potato Special	(Made for) A. G. & F. Wheeler, Stonington	Wheeler Bros.	**33.00**	24
22852*	Hubbard's Oats and Top Dressing	Rogers & Hubbard Co., Middletown	Manufacturer	57.00	42
			W. L. L. Ellis, Ansonia	**57.00**	
22937	Sanderson's Formula B, for Tobacco	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	**35.00**	26
			G. B. Ferris, New Milford	....	
			A. E. Phelps, Glastonbury	32.30	
22778	Wilcox's H. G. Tobacco Special	Wilcox Fertilizer Co., Mystic	Manufacturer	....	26
			M. E. Thompson, Ellington	35.00	
			F. J. Hartz, South Manchester	**35.00**	

* See note page 73. † Purchaser.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.*							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22563	27.6	1.00	---	2.00	3.00	2.9	7.63	4.19	1.23	13.05	....	11.82	8.0	7.56	7.56	7.
22833	27.7	0.57	0.64	3.51	4.72	4.1	2.35	2.12	0.51	4.98	4.0	4.47	3.0	0.97	5.81	5.
22450	28.0	....	0.85	2.79	3.64	3.3	0.34	6.53	1.20	8.07	....	6.87	6.0	7.88	11.27	10
22772	28.7	2.86	0.12	0.25	3.23	2.5	....	14.26	4.53	18.79	18.0	14.26	....	11.81	11.81	10
22687	28.8	2.00	0.10	2.26	4.36	4.0	6.41	2.29	0.45	9.15	....	8.70	7.0	7.40	7.40	7
22957	29.4	2.27	0.18	1.78	4.23	4.1	4.77	3.15	1.00	8.92	7.0	7.92	6.0	4.19	6.38	5.
22892	30.1	1.28	0.12	2.84	4.24	4.5	0.10	6.06	2.55	8.71	6.0	6.16	5.0	0.25	7.72	5.
22573	31.0	....	0.10	3.18	3.28	3.0	2.37	5.34	1.53	9.24	8.0	7.71	....	4.53	4.53	4.
22562	32.4	6.40	0.02	1.52	7.94	8.5	0.14	8.02	2.88	11.04	8.0	8.16	4.5	9.73	9.73	8.
22688	32.5	1.24	0.08	1.35	2.67	2.8	6.30	1.94	0.38	8.62	....	8.24	8.0	10.43	10.43	10,
22852	32.7	7.22	0.02	1.11	8.35	8.5	0.07	5.93	2.51	8.51	8.0	6.00	4.50	11.32	11.32	8.
22937	33.0	1.77	0.06	1.92	3.75	3.3	5.06	2.44	1.71	9.21	10.0	7.50	6.0	1.90	6.81	6.
22778	33.2	0.98	0.10	2.55	3.63	3.3	0.06	4.53	6.41	11.00	7.0	4.59	5.0	1.18	7.34	7.

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22708	Vegetable and Potato	Buffalo Fertilizer Co., Buffalo, N. Y.	J. R. Reinhard & Sons, Cheshire	$34.00	$25.
			Manchester Elevator Co., Manchester	34.00	
22928	Hubbard's Grass and Grain Fertilizer	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	42.00	30.
			Arthur Manning, R.D., South Manchester	42.00	
22911‡	Chittenden's H. G. Special Tobacco Fertilizer	National Fertilizer Co., New York City	J. M. Lasbury, Broad Brook	46.00	33.
22689	Wheeler's Corn Special	(Made for) A. G. & F. Wheeler, Stonington	Wheeler Bros.	31.00	22.
22621	Top Dresser	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	40.00	29.
			J. & H. Woodford, Avon	41.00	
			Manchester Elevator Co., Manchester	40.00	
				40.25	
22943	Swift's Lowell Potato Grower	Swift's Lowell Fertilizer Co., Boston	G. S. Jennings, Southport	36.00	26.
22924	Hubbard's Potato Manure	Rogers & Hubbard Co., Middletown	John Hoffman,* Cromwell	....	31.
				44.00	
22942	Swift's Tobacco Manure	Swift's Lowell Fertilizer Co., Boston	J. & H. Woodford, Avon	43.00	31.
23364†	N. E. Perfect Tobacco Grower	New England Fertilizer Co., Boston	T. J. Kennedy, R. D., Thompsonville	35.00	25.
22707	Ideal Wheat and Corn	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	27.00	20.1
			J. R. Reinhard & Sons, Cheshire	29.00	
				28.00	
22893	Peruvian Vegetable Grower	Coe-Mortimer Co., New York City	R. H. Morgan, West Cheshire	43.00	30.8
22897	3-6-10 for Potatoes	Lister's Agric. Chem. Works, Newark, N. J.	Herman Ude, Suffield	34.00	24.3
22930	Complete Corn and Onion	Rogers Mfg. Co., Rockfall	Thos. Holt, Southington	35.00	25.4
			E. T. Hulburt, Somers	37.00	
			N. H. Root, New Milford	35.00	
				35.75	

* Purchaser. † See note page 73. ‡ See note on page 74.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.*							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22708	35.6	....	2.86	0.94	3.80	2.5	5.32	3.14	1.48	9.94	9.0	8.46	8.0	5.56	5.56	7.
22928	35.7	0.20	0.17	2.61	2.98	2.2	0.34	9.22	5.22	14.78	16.0	9.56	6.6	12.93	12.93	12.
22911	35.9	....	2.56	2.76	5.32	5.8	4.36	1.90	0.83	7.09	6.0	6.26	5.0	1.79*	9.79	10.
22689	36.6	0.99	0.36	1.33	2.68	2.1	6.48	1.85	0.38	8.71	....	8.33	8.0	7.67	7.67	8.
22621	36.7	1.03	3.30	1.05	5.38	5.7	4.63	2.74	1.16	8.53	7.0	7.37	6.0	5.60	5.60	5.
22943	37.2	0.71	0.10	2.56	3.37	3.3	5.23	1.34	0.35	6.92	7.0	6.57	6.0	10.08	10.08	10.
22924	38.4	2.43	0.32	2.43	5.18	5.0	0.40	8.77	2.92	12.09	10.0	9.17	7.0	1.20	6.00	5.
22942	38.6	0.68	0.08	3.40	4.16	4.0	3.38	3.89	0.92	8.19	7.0	7.27	60	1.25	10.0	10.
23364	38.9	0.69	0.15	3.03	3.87	4.0	0.24	5.56	1.13	6.93	5.0	5.80	4.0	0.93	6.51	6.
22707	39.0	0.32	0.91	0.83	2.06	1.6	5.92	3.61	1.22	10.75	10.0	9.53	9.0	5.98	5.98	6.
22893	39.4	1.02	1.02	1.72	3.76	3.3	4.26	4.78	1.00	10.04	10.0	9.04	8.0	1.99	10.61	9.
22897	39.6	0.08	1.08	1.57	2.73	2.5	4.72	2.09	0.87	7.68	7.0	6.81	6.0	10.44	10.44	10.
22930	40.7	1.46	0.38	1.74	3.58	3.5	4.79	3.45	1.30	9.54	.0	8.24	6.0	6.95	6.95	7.

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22453	Corn and Potatoes	Olds & Whipple, Hartford	Manufacturer	$34.00	$24.1
22736	Wheeler's Havana Tobacco Grower	Amer. Agric. Chem. Co., N. Y. City	F. M. Loomis, Granby	35.00	25.5
			G. A. Peckham, Suffield	38.00	
			L. L. Loomis, Granby	35.00	
				36.00	
22752	Lister's Potato Manure	Lister's Agric. Chem. Works, Newark, N. J.	J. C. Wilcoxson, Stratford	38.00	26.4
			D. H. Carrier & Son, Glastonbury	37.50	
			H. N. Fuller, Windsor Locks	36.50	
				37.25	
22835	Stockbridge Tobacco Manure	Bowker Fertilizer Co., N. Y. City	W. H. Filley,* Windsor	51.00	34.3
			F. R. Green, New Milford	46.00	
				48.50	
22741	Home Mixture for Corn and Potatoes	Olds & Whipple, Hartford	J. R. Gregg, Suffield	34.00	23.8
			H. L. Spear, Suffield	**34.00**	
22796	H. G. Tobacco Manure	Amer. Agric. Chem. Co., N. Y. City	Broad Brook Lumber Co., Broad Brook	**50.00**	35.0
22517	Chittenden's Eureka Potato Fertilizer	National Fertilizer Co., N. Y. City	H. A. Bugbee, Willimantic	35.00	24.3
			G. D. Mosher, Milford	**35.00**	
22832	Grass Special	Berkshire Fertilizer Co., Bridgeport	Jacob Glover, Stafford	39.00	26.0
			Avery Bros., Norwich Town	36.00	
				37.50	
22559	Stockbridge Top Dressing	Bowker Fertilizer Co., N. Y. City	Lightbourn & Pond Co., New Haven	40.00	27.81
			J. Frank Elwood, Greens Farms	39.00	
			East Berlin Mill Co., East Berlin	42.00	
				40.25	
23009	Lister's Special Grass Mixture	Lister's Agric. Chem. Works, Newark, N. J.	D. H. Carrier & Son, Glastonbury	**36.00**	24.77
22916†	Chittenden's Conn. Valley Tobacco Starter	*National Fertilizer Co., N. Y. City*	J. M. Lasbury, *Broad Brook*	***48.00***	*33.02*
22705	Stockbridge Corn and Grain	Bowker Fertilizer Co., N. Y. City	W. B. Martin, Rockville	39.00	27.01
			A. R. Manning, Yantic	40.00	
				39.50	

* Purchaser. † See note on page 74.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
2453	40.9	1.13	0.10	2.39	3.62	**3.3**	0.45	6.33	1.47	8.25	....	6.78	**6.0**	6.59	6.59	**6.0**
2736	41.0	0.11	1.20	1.41	2.72	**2.5**	5.91	0.86	0.78	7.55	**7.0**	6.77	**6.0**	0.90	10.23	**10.0**
2752	41.0	0.32	1.62	1.71	3.65	**3.3**	7.05	1.59	0.95	9.59	**9.**	8.64	**8.0**	7.30	7.30	**7.0**
2835	41.1	....	3.92	1.78	5.70	**5 8**	3.50	2.00	0.92	6.42	**6.0**	5.50	**4.0**	0.81	9.84	**10.0**
2741	42.6	1.06	0.05	2.48	3.59	**3.3**	0.49	5.86	1.71	8.06	....	6.35	**6.0**	6.58	6.58	**6.0**
2796	42.6	0.28	3.24	2.16	5.68	**5.8**	4.71	1.35	0.23	6.29	**6.0**	6.06	**5.0**	0.68	10.20	**10.0**
2517	43.6	0.64	0.46	1.51	2.61	**2.5**	5.14	2.11	0.96	8.21	**7.0**	7.25	**6.0**	8.68	10.30	**10.0**
2832	44.2	2.38	0.16	2.62	5.16	**5.0**	2.79	2.84	0.47	6.10	**5.0**	5.63	**4.0**	3.81	3.81	**2.0**
2559	44.7	....	2.36	2.56	4.92	**4.9**	3.23	2.75	1.06	7.04	**6.0**	5.98	**4.0**	6.04	6.04	**6.0**
3009	45.3	0.08	0.61	1.26	1.95	**1.7**	9.81	1.01	0.31	11.13	**11.0**	10.82	**10.0**	10.55	10.55	**10.0**
2916	45.4	0.23	4.00	3.47	7.70	**8.3**	0.37	2.68	0.84	3.89	**3.0**	3.05	....	0.31	3.00	**3.0**
2705	46.2	1.46	0.10	1.94	3.50	**3.3**	4.51	5.92	1.98	12.41	**11.0**	10.43	**10.0**	6.99	6.99	**7.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton
	Sampled by Station Agent:				
23007*	Broad Brook Market and Potato Special	(Made for) Broad Brook Lumber & Coal Co.	Broad Brook Lumber & Coal Co.	$34.00	$23.
22519	North Western 10% Potato Fertilizer	Amer. Agric. Chem. Co., N. Y. City	Edmund Halladay, Suffield	36.00	23.
			D. L. Clark, Milford	32.00	
				34.00	
22703	*Packers' Union Potato Manure*	*Amer. Agric. Chem. Co., N. Y. City*	F. L. Mackey, Ellington	33.00	21.
			G. A. Forsyth, Waterford	**32.00**	
			W. H. Billings, Somerville	31.00	
22777	Swift's Perfect Tobacco Grower	Swift's Lowell Fertilizer Co., Boston	J. & H. Woodford, Avon	39.00	25.
			J. D. Beasley, Ellington	35.00	
			F. S. Bidwell & Co., Windsor Locks	41.00	
				38.25	
22939	Swift-Sure Guano for Truck, Corn and Onions	M. L. Shoemaker & Co., Phila., Pa.	F. H. Rolf, Guilford	**30.00**	20.
22933	Complete Potato and Vegetable Fertilizer	Rogers Mfg. Co., Rockfall	Manufacturer	33.00	22.
			F. U. Wadhams, Torrington	**33.00**	
22569	Mapes' Economical Potato Manure	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford	37.00	25.
			A. N. Clark, Milford	38.00	
			Southington Lumber Co., Southington	38.00	
				37.75	
22510	Essex Tobacco Starter and Grower	Essex Fertilizer Co., Boston	W. K. Ackley, East Hartford	39.00	26.
			Spencer Bros., Suffield	**39.00**	
22917†	N. E. Perfect Tobacco Grower	New England Fertilizer Co., Boston	James Case, Collinsville	**38.00**	25.
22516	Chittenden's Potato Phosphate	National Fertilizer Co., N. Y. City	H. A. Bugbee, Willimantic	30.00	20.
			D. L. Clark, Milford	30.00	
			G. D. Mosher, Milford	31.00	
				30.25	
22443	Stockbridge Potato and Vegetable	Bowker Fertilizer Co., N. Y. City	Lightbourn & Pond Co., New Haven	40.00	26.
			W. T. McKenzie, Yalesville	39.00	
			A. D. Bridge's Sons, Hazardville	40.00	
				39.75	

* See notes pages 72 and 74. † See note on page 73.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.*							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
23007	46.6	1.18	0.05	1.09	3.32	5.0	7.62	1.70	0.45	9.77	----	9.32	----	0.60	7.62	7.
22519	47.0	0.26	0.17	1.41	1.84	1.7	3.98	4.89	1.94	10.81	9.0	8.87	8.0	10.53	10.53	10.
22703	47.9	0.61	0.36	1.41	2.38	2.1	6.21	2.64	2.16	11.01	9.0	8.85	8.0	6.30	6.30	6.
22777	48.4	0.88	0.15	3.07	4.10	4.0	0.46	5.32	1.22	7.00	5.0	5.78	4.0	1.75	6.38	6.
22939	48.5	0.73	0.02	1.11	1.86	1.7	6.27	3.85	1.61	11.73	---	10.12	8.0	6.05	6.05	5.
22933	48.5	1.25	0.08	1.20	2.53	2.3	6.70	3.44	2.64	12.78	10.0	10.14	8.0	5.21	5.21	5.
22569	48.5	1.84	0.96	0.72	3.52	3.3	0.67	5.36	0.79	6.82	6.0	6.03	4.0	1.12	8.91	8.
22510	48.7	0.82	0.14	3.19	4.15	4.0	0.29	5.78	0.90	6.97	5.0	6.07	4.0	1.30	6.47	6.
22917	49.0	0.64	0.12	2.84	3.60	4.1	1.67	4.91	1.25	7.83	5.0	6.58	4.0	1.74	7.18	6.
22516	49.1	0.32	0.72	1.06	2.10	2.1	6.73	1.97	1.73	10.43	9.0	8.70	8.0	6.23	6.23	6.
22443	49.9	----	1.80	1.61	3.41	3.3	3.94	2.61	1.54	8.09	7.0	6.55	6.0	10.20	10.20	10.

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	V[illegible]
	Sampled by Station Agent:				
22894	Essex Grass and Top Dressing	Essex Fertilizer Co., Boston	W. K. Ackley, East Hartford	$45.00	$30.
22740	Essex Complete for Corn, Grain and Grass	Essex Fertilizer Co., Boston	W. K. Ackley, East Hartford	41.40	26.
			H. Thompson, Plainville	**40.00**	
			Broad Brook Lumber Co., Broad Brook	39.00	
22481	Essex Complete for Potatoes, Roots and Vegetables	Essex Fertilizer Co., Boston	W. K. Ackley, East Hartford	41.00	26.
			Spencer Bros., Suffield	41.00	
			Knowles-Lombard Co., Guilford	39.00	
				40.25	
22927	Hubbard's Soluble Corn and General Crops	Rogers & Hubbard Co., Middletown	N. H. Sherwood, Southport	35.00	24.
			John Hoffman,* Cromwell	38.00	
				36.50	
22803	East India Potato Manure	Amer. Agric. Chem. Co., N. Y. City	A. H. Cashen, Meriden	42.00	26..
			F. J. Hartz, R. D., So. Manchester	38.00	
				40.00	
22944	Swift's Lowell Special Corn and Vegetable Manure	Swift's Lowell Fertilizer Co., Boston	G. S. Jennings, Southport	35.00	24.[illegible]
			F. E. Weed & Co., New Canaan	40.00	
				37.50	
22798	Tobacco Starter and Grower	Amer. Agric. Chem. Co., N. Y. City	Arthur Manning, So. Manchester	35.50	24.[illegible]
			A. D. Bridge's Sons, Hazardville	39.00	
				37.25	
22447	Mapes' Potato Manure	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford	40.00	26.8
			Spencer Bros., Suffield	41.00	
			F. S. Bidwell & Co., Windsor Locks	**41.00**	
			J. P. Barstow, Norwich	42.00	
22959	Wilcox's Potato Fertilizer	Wilcox Fertilizer Co., Mystic	Manufacturer	28.50	18.7
			W. A. Howard, Woodstock	29.00	
				28.75	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
2894	49.9	0.62	0.17	3.65	4.44	**4.0**	5.45	2.85	0.91	9.21	**8.0**	8.30	**7.0**	8.01	8.01	**8.0**
2740	50.0	0.88	0.05	2.39	3.32	**3.3**	5.04	1.83	0.81	7.68	**7.0**	6.87	**6.0**	10.46	10.46	**10.0**
2481	50.9	0.90	0.10	2.30	3.30	**3.3**	4.80	2.12	0.82	7.74	**7.0**	6.92	**6.0**	10.57	10.57	**10.0**
2927	51.1	0.85	0.10	1.77	2.72	**2.5**	2.61	5.54	1.29	9.44	**8.0**	8.15	**5.5**	9.15	9.15	**8.0**
2803	51.5	....	2.26	1.15	3.41	**3.3**	5.42	1.29	0.38	7.09	**7.0**	6.71	**6.0**	9.25	10.36	**10.0**
2944	51.8	0.77	0.08	2.30	3.15	**3.3**	6.60	1.98	0.93	9.51	**9.0**	8.58	**8.0**	7.19	7.19	**7.0**
2798	52.1	0.86	1.02	1.46	3.34	**3.3**	6.36	2.89	1.36	10.61	**9.0**	9.25	**8.0**	0.65	5.12	**4.0**
2447	52.6	1.63	1.62	0.49	3.74	**3.7**	1.79	7.19	0.78	9.76	**8.0**	8.98	**8.0**	0.70	7.45	**6.0**
2959	53.0	0.49	0.22	1.71	2.42	**2.1**	2.30	4.00	2.07	8.37	**7.0**	6.30	**6.0**	3.47	4.97	**4.5**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22704	Bowker's Early Potato Manure	Bowker Fertilizer Co., N. Y. City	W. T. McKenzie, Yalesville	$38.00	$24.8
			J. Frank Elwood, Greens Farms	38.00	
22935	Tobacco Starter	Rogers Mfg. Co., Rockfall	E. T. Hulburt, Somers	34.00	22.8
			G. H. Sloan, Windsorville	36.00	
				35.00	
22915	Chittenden's Complete Root	National Fertilizer Co., N. Y. City	G. A. Williams, Silver Lane	**38.00**	24.7
22679	Grass and Lawn Top Dressing	Amer. Agric. Chem. Co., New York City	R. H. Hall, East Hampton	38.00	24.3
			G. L. Dennis, Stafford Springs	37.00	
				37.50	
22620	Celery and Potato Special	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	32.00	21.5
			J. R. Reinhard & Sons, Cheshire	34.00	
			J. & H. Woodford, Avon	34.00	
				33.25	
22645	Bradley's Complete Manure for Potatoes and Vegetables	Amer. Agric. Chem. Co., New York	G. L. Dennis, Stafford Springs	39.00	24.7
			W. B. Martin, Rockville	38.00	
			Avery Bros., Norwich Town	38.00	
				38.25	
22898	Lister's Special Tobacco Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	G. O. Case, Burnside	**30.00**	19.4
22774	Chittenden's Complete Tobacco Fertilizer	National Fertilizer Co., New York City	S. O. Ranney,* R. D., Windsor Locks	38.00	24.5
			J. M. Clark, Simsbury	**38.00**	
22923	Special Potato Fertilizer	Parmenter & Polsey Fertilizer Co., Boston	J. C. Green, R. D., Eagleville	**39.00**	25.1
22840	Essex Special Tobacco Manure	Essex Fertilizer Co., Boston	F. T. Blish Hdw. Co., South Manchester	45.00	28.6
			W. K. Ackley, East Hartford	**45.00**	
22926	Hubbard's Potato Phosphate	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	32.00	20.6
			F. S. Platt Co., New Haven	33.00	
				32.50	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22704	53.0	....	1.42	1.98	3.40	3.3	4.86	3.11	1.69	9.66	8.0	7.97	7.0	6.74	6.74	7.
22935	53.4	1.32	0.24	2.32	3.88	3.8	2.91	3.25	1.43	7.59	5.0	6.16	4.0	0.40	3.70	3.
22915	53.7	....	1.98	1.35	3.33	3.3	7.66	1.54	0.87	10.07	9.0	9.20	8.0	6.25	6.25	6.
22679	54.0	5.16	0.02	0.02	5.20	3.9	2.02	4.29	1.37	7.68	6.0	6.31	5.0	2.35	2.35	2.
22620	54.1	....	1.12	0.69	1.81	1.6	5.70	3.36	1.30	10.36	9.0	9.06	8.0	9.08	9.08	10.
22645	54.5	1.52	0.20	1.50	3.22	3.3	5.84	2.87	1.65	10.36	9.0	8.71	8.0	7.08	7.08	7.
22898	54.6	....	0.64	1.86	2.50	2.1	5.91	3.05	1.47	10.43	9.0	8.96	8.0	0.72	2.81	3.
22774	54.7	0.27	1.00	2.03	3.30	3.3	7.01	2.36	1.20	10.57	9.0	9.37	8.0	1.90	5.10	5.
22923	55.3	0.80	0.08	2.37	3.25	3.3	6.32	2.13	1.11	9.56	9.0	8.45	8.0	7.30	7.30	7.
22840	57.1	0.90	0.08	2.82	3.80	4.0	2.69	3.59	1.22	7.50	7.0	6.28	6.0	4.70	10.23	10.
22926	57.2	0.82	0.06	1.27	2.15	2.0	5.96	4.13	0.35	10.44	10.0	10.09	9.0	6.05	6.05	5.

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22609	Swift's Lowell Potato Phosphate	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	$36.00	$21.
			Standard Feed Co., Bridgeport	33.00	
			J. & H Woodford, Avon	34.00	
				34.25	
22899	Lister's Special Potato	Lister's Agric. Chem. Works, Newark, N.J.	H. N. Fuller, Windsor Locks	27.50	17.
22879	Darling's Potato Manure	Amer. Agric. Chem. Co., New York City	Elmer Rose, Wallingford	32.00	20.
22618	Armour H. G. Potato	Armour Fertilizer Works, Baltimore, Md.	Lightbourn & Pond Co., New Haven	33.00	21.
			E. A. Buck & Co., Willimantic	34.00	
			F. T. Blish Hdw. Co., So. Manchester	36.00	
				34.25	
22756	Potato and Vegetable Manure	Niantic Menhaden Oil & Guano Co., South Lyme	F. H. Rolf, Guilford	31.00	20.
			J. P. Barstow & Co., Norwich	34.00	
			J. O. Fox, Putnam	35.00	
				33.25	
22479	Quinnipiac Potato Manure	Amer. Agric. Chem. Co., New York City	C. Buckingham, Southport	30.00	19.
			Gault Bros., Westport	33.00	
			Meeker Coal Co., Norwalk	33.00	
				32.00	
22755	Corn & Grain Fertilizer	Niantic Menhaden Oil & Guano Co., South Lyme	F. H. Rolf, Guilford	**31.00**	19.:
			J. P. Barstow & Co., Norwich	32.00	
			J. O. Fox, Putnam	30.00	
22837	E. F. Coe's Tobacco and Onion Fertilizer	Coe-Mortimer Co., New York City	W. A. Burr, West Hartford	40.00	23.
			L. A. Gowdy, Hazardville	37.00	
				38.50	
22686	Sanderson's Corn Superphosphate	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	28.00	17.
			R. H. Hall, East Hampton	27.00	
				27.50	
22883	Read's Vegetable and Vine Fertilizer	Amer. Agric. Chem. Co., New York City	A. H. Cashen, Meriden	**34.00**	21.
22851	N. E. High Grade Potato	N. E. Fertilizer Co., Boston	B. F. Eddy, East Woodstock	35.00	
			James Case, Collinsville	**35.00**	21.:

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22609	57.4	....	0.20	2.30	2.50	**2.5**	6.72	2.12	0.78	9.62	**9.0**	8.84	**8.0**	6.08	6.08	**6.0**
22899	57.5	....	0.28	1.64	1.92	**1.7**	5.81	3.37	1.30	10.48	**8.0**	9.18	**8.0**	3.23	3.23	**3.0**
22879	57.6	0.14	0.74	1.84	2.72	**2.5**	4.21	2.72	1.45	8.38	**7.0**	6.93	**6.0**	5.27	5.27	**5.0**
22618	58.1	0.36	0.42	0.92	1.70	**1.7**	6.72	1.57	0.35	8.64	**8.5**	8.29	**8.0**	10.49	10.49	**10.0**
22756	59.3	0.37	0.38	1.97	2.72	**2.5**	5.18	3.07	0.77	9.02	**8.0**	8.25	**7.0**	0.47	4.34	**4.0**
22479	60.1	0.11	0.70	1.83	2.64	**2.5**	4.43	2.51	1.38	8.32	**7.0**	6.94	**6.0**	5.23	5.23	**5.0**
22755	60.5	....	0.30	2.04	2.34	**2.1**	5.57	2.39	0.64	8.60	**8.0**	7.96	**7.0**	0.60	4.24	**3.5**
22837	60.8	0.52	1.10	1.47	3.09	**3.0**	4.51	1.40	0.63	6.54	**7.0**	5.91	**6.0**	4.52	8.73	**8.0**
22686	61.2	0.12	0.08	1.62	1.82	**1.7**	6.24	2.25	0.98	9.47	**9.0**	8.49	**7.0**	3.85	3.85	**2.0**
22883	61.4	0.08	0.24	1.82	2.14	**1.1**	6.90	2.04	1.10	10.04	**9.0**	8.94	**8.0**	6.67	6.67	**6.0**
22851	62.3	....	0.10	2.30	2.40	**2.5**	6.89	1.74	0.96	9.59	**9.0**	8.63	**8.0**	6.33	6.33	**6.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
23008	Lister's Corn Fertilizer No. 2	Lister's Agric. Chem. Works, Newark, N. J.	G. O. Case, Burnside	$31.00	$19.01
22881	Quinnipiac Potato Phosphate	Amer. Agric. Chem. Co., New York City	G. M. Williams Co., New London	30.00	18.36
22572	Sanderson's Potato Manure	Sanderson Fert. and Chem. Co., New Haven	Manufacturer	30.00	18.50
			Morse & Landon, Guilford	30.00	
			G. W. Eaton Estate, Plainville	31.00	
				30.25	
22614	Great Eastern Northern Corn Special	Amer. Agric. Chem. Co., New York City	F. M. Loomis, Granby	30.00	19.20
			R. H. Hall, East Hampton	33.00	
				31.50	
22508	*Bradley's Corn Phosphate*	Amer. *Agric. Chem.* Co., New York City	F. S. Bidwell & Co., Windsor Locks	32.00	17.66
			S. B. Potter, Norwich	29.00	
			D. L. Clark, Milford	27.00	
				29.25	
22749	Great Eastern Vegetable, Vine and Tobacco	Amer. Agric. Chem. Co., New York City	R. H. Hall, East Hampton	33.00	19.89
			Fred Morton, Rocky Hill	34.00	
			T. E. Green, Plainfield	32.00	
2616	Corn King	Armour Fertilizer Works, Baltimore, Md.	T. H. Eldredge, Norwich	34.00	19.99
			O. H. Meeker, Danbury	32.00	
			F. T. Blish Hdw. Co., South Manchester	34.00	
				33.25	
2605	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., New York City	J. Frank Elwood Greens Farms	33.00	20.69
			East Berlin Mill Co., East Berlin	36.00	
				34.50	
2603	Potato and Vegetable Phosphate	Berkshire Fertilizer Co., Bridgeport	F. C. Benjamin & Co., Danbury	30.00	18.56
			Hotchkiss & Templeton, Waterbury	32.00	
				31.00	
2875	Bradley's Complete Manure for Top Dressing Grass [illegible]	Amer. Agric. Chem. [illegible]	A. D. Bridge's Sons, [illegible]	[illegible]	23.89

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
3008	63.1	0.06	1.00	0.92	1.98	**1.7**	8.41	1.95	0.71	11.07	**11.0**	10.36	**10.0**	4.15	4.15	**4.0**
2881	63.4	0.28	0.75	1.29	2.32	**2.1**	7.18	1.60	1.73	10.51	**10.0**	8.78	**8.0**	2.87	2.87	**3.0**
2572	63.5	....	0.23	1.75	1.98	**1.7**	3.89	1.87	0.69	6.45	**8.0**	5.76	**5.0**	7.49	7.49	**6.0**
2614	64.1	0.48	0.64	1.33	2.45	**2.5**	6.58	3.34	1.73	11.65	**11.0**	9.92	**9.0**	2.47	2.47	**2.0**
2508	65.6	0.22	0.58	1.48	2.28	**2.1**	6.38	2.44	1.29	10.11	**9.0**	8.82	**8.0**	2.37	2.37	**1.5**
2749	65.9	0.80	0.18	1.14	2.12	**2.1**	5.93	2.89	1.71	10.53	**9.0**	8.82	**8.0**	5.73	5.73	**6.0**
2616	66.3	0.58	0.51	1.52	2.61	**2.5**	6.75	1.80	0.53	9.08	**9.0**	8.55	**8.0**	4.35	4.35	**4.0**
2605	66.8	....	0.98	1.54	2.52	**2.5**	6.72	3.12	2.03	11.87	**9.0**	9.84	**8.0**	3.69	3.69	**4.0**
2603	67.0	....	0.10	2.26	2.36	**1.7**	4.66	2.89	0.19	7.74	**7.0**	7.55	**6.0**	4.47	4.47	**4.0**
2875	67.4	4.92	0.06	0.04	5.02	**4.9**	1.88	4.53	1.37	7.78	**6.0**	6.41	**5.0**	2.45	2.45	**2.5**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
22805	Packers' Union Animal Corn Fertilizer	Amer. Agric. Chem. Co., New York City	G. A. Forsyth, Waterford	$32.00	$18.[illegible]
			W. H. Billings, Somerville	31.00	
				31.50	
22512	Mapes' Corn Manure	Mapes F. & P. G. Co., New York City	F. S. Bidwell & Co., Windsor Locks	37.00	21.[illegible]
			J. P. Barstow & Co., Norwich	35.00	
			Birdsey & Raven, Meriden	38.00	
				36.75	
22966	P. & P. Potato Fertilizer	Parmenter & Polsey Fertilizer Co., Boston	Arthur Williams, South Woodstock	**31.00**	18.3
22802	Crocker's Potato, Hop and Tobacco	Amer. Agric. Chem. Co., New York City	F. M. Loomis, Granby	31.00	18.1
			L. L. Loomis, Granby	**31.00**	
22841	Lister's Special Corn Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	J. C. Wilcoxson, Stratford	28.00	17.5
			H. N. Fuller, W. Locks	32.00	
				30.00	
22822	Quinnipiac Corn Manure	Amer. Agric. Chem. Co., New York City	Gault Bros., Westport	31.00	17.7
			J. P. Lathrop, Plainfield	30,00	
				30.50	
22478	Bradley's Potato Manure	Amer. Agric. Chem. Co., New York City	Spencer Bros., Suffield	34.00	19.5
			F. S. Bidwell & Co., Windsor Locks	34.00	
			S. B. Potter, Norwich	33.00	
				33.75	
22554	Bradley's Potato Fertilizer	Amer. Agric. Chem. Co., New York City	H. K. Brainard, Thompsonville	34.00	18.6
			S. B. Potter, Norwich	31.00	
			Wilson & Burr, Middletown	32.00	
				32.25	
22829	Williams & Clark's Potato Manure	Amer. Agric. Chem. Co., New York City	Carlos Bradley, Ellington	32.00	18.2[illegible]
			Collinsville Grain Co., Collinsville	31.00	
				31.50	
22828	Williams & Clark's Potato Phosphate	Amer. Agric. Chem. Co., New York City	D. B. Wilson Co., Waterbury	35.00	19.8[illegible]
			George Beaumont, Wallingford	34.00	
				34.50	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed	As Muriate.	Total.	
2805	68.2	0.48	0.66	1.26	2.40	2.5	6.75	2.77	1.74	11.26	11.0	9.52	9.0	2.45	2.45	2.0
2512	68.6	1.14	0.70	0.68	2.52	2.5	0.82	8.41	1.64	10.87	10.0	9.23	8.0	6.90	6.90	6.0
2966	68.7	0.15	0.10	1.73	1.98	1.6	5.12	2.05	0.60	7.77	7.0	7.17	6.0	6.10	6.10	6.0
2802	70.4	....	0.80	1.40	2.20	2.1	6.22	2.59	1.62	10.43	9.0	8.81	8.0	3.19	3.19	3.0
2841	71.2	0.08	0.23	1.65	1.96	1.7	5.87	2.90	1.39	10.16	9.0	8.77	8.0	3.43	3.43	3.0
2822	71.8	0.29	0.20	1.79	2.28	2.1	6.09	2.85	2.11	11.05	9.0	8.94	8.0	1.88	1.88	1.5
2478	72.8	0.51	0.70	1.46	2.67	2.5	4.24	2.15	1.54	7.93	7.0	6.39	6.0	5.18	5.18	5.0
2554	73.1	0.24	0.79	1.29	2.32	2.1	6.86	2.23	1.71	10.80	10.0	9.09	8.0	2.97	2.97	3.0
2829	73.1	0.41	0.48	1.29	2.18	2.1	6.04	3.08	1.61	10.73	9.0	9.12	8.0	3.16	3.16	3.0
2828	73.5	0.22	1.10	1.26	2.58	2.5	4.44	2.70	1.55	8.69	7.0	7.14	6.0	5.38	5.38	5.0

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
54	N. E. Corn Phosphate	N. E. Fertilizer Co., Boston	B. F. Eddy, East Woodstock	$28.00	$16.70
			James Case, Collinsville	30.00	
				29.00	
31	Fruit and Root Crop Special	Armour Fertilizer Works, Baltimore, Md.	T. H. Eldredge, Norwich	30.00	16.67
			Young Bros Co., Danielson	28.00	
				29.00	
34	Bowker's Tobacco Starter	Bowker Fertilizer Co., New York City	A. D. Bridge's Sons, Hazardville	**36.00**	20.58
			R. A. Hardin, Glastonbury	......	
09	Mapes' Fruit and Vine Manure	Mapes F. & P. G. Co., New York City	Birdsey & Raven, Meriden	**43.00**	24.47
25	Wheeler's Potato Manure	Amer. Agric. Chem. Co., New York City	W. A. Collins, Jr., Columbia	30.00	17.81
			T. W. Crane, Danbury	34.00	
				32.00	
17	Complete Potato	Armour Fertilizer Works, Baltimore, Md.	O. H. Meeker, Danbury	30.00	17.21
			S. V. Osborn, Branford	32.00	
			F. T. Blish Hdw. Co., South Manchester	32.00	
				31.25	
24	Wheeler's Corn Fertilizer	Amer. Agric. Chem. Co., New York City	W. A. Collins, Jr., Columbia	29.00	16.74
			T. W. Crane, Danbury	32.00	
				30.50	
56	Essex Market Garden and Potato Manure	Essex Fertilizer Co., Boston, Mass.	W. K. Ackley, East Hartford	35.00	18.97
			W. O. Goodsell, Bristol	35.00	
			H. C. Thompson, Plainville	34.00	
				34.75	
01	Crocker's Ammoniated Corn Phosphate	Amer. Agric. Chem. Co., New York City	J. R. Gregg, Suffield	31.00	16.91
			G. A. Peckham, Suffield	**31.00**	
58	Armour's Grain Grower	Armour Fertilizer Works, Baltimore, Md.	Lightbourn & Pond, New Haven	29.00	15.09
			T. H. Eldredge, Norwich	28.00	
			O. H. Meeker, Danbury	26.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.	
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.	
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.
22954	73.6	....	0.02	1.72	1.74	**1.6**	6.15	2.83	1.09	10.07	**9.0**	8.98	**8.0**	3.23	3.23
22831	74.0	0.74	0.34	0.57	1.65	**1.7**	5.65	2.59	0.73	8.97	**8.5**	8.24	**8.0**	5.03	5.03
22834	74.9	....	1.10	1.62	2.72	**2.5**	5.66	3.18	2.16	11.00	**9.0**	8.84	**8.0**	0.47	3.13
22909	75.7	1.57	0.08	0.50	2.15	**1.7**	0.36	6.84	1.06	8.26	**7.0**	7.20	**5.0**	1.20	11.80
22825	79.7	0.70	0.12	1.26	2.08	**2.1**	5.28	3.54	2.44	11.26	**9.0**	8.82	**8.0**	3.08	3.08
22617	81.6	0.68	0.28	0.76	1.72	**1.7**	5.76	1.06	0.32	7.14	**7.5**	6.82	**7.0**	6.65	6.65
22824	82.2	0.17	0.14	1.67	1.98	**1.7**	5.98	2.72	1.93	10.63	**9.0**	8.70	**8.0**	2.24	2.24
22566	83.2	....	0.01	2.09	2.10	**2.1**	6.75	1.31	0.90	8.96	**9.0**	8.06	**8.0**	5.08	5.08
22801	83.3	....	0.92	1.20	2.12	**2.1**	6.65	2.65	1.51	10.81	**9.0**	9.30	**8.0**	1.69	1.69
22558	83.9	0.08	0.23	1.38	1.69	**1.7**	6.14	2.29	0.58	9.01	**8.5**	8.43	**8.0**	2.43	2.43

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	
	Sampled by Station Agent:				
22827	Williams & Clark's Corn Phosphate	Amer. Agric. Chem. Co., New York City	Phineas Platt, Milford	$32.00	$1
			George Beaumont, Wallingford	32.00	
22843	Mapes' Cereal Brand	Mapes F. & P. G. Co., New York City	Mapes' Branch, Hartford	30.00	15
			A. N. Clark, Milford	**30.00**	
22823	Read's Practical Potato Special	Amer. Agric. Chem. Co., New York City	A. H. Cashen, Meriden	32.00	16
			C. W. Fulton, West Hartford	31.00	
				31.50	
22604	Bowker's Corn Phosphate	Bowker Fertilizer Co., New York City	W. T. McKenzie, Yalesville	31.00	16
			East Berlin Mill Co., East Berlin	32.00	
				31.50	
22648	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., New York City	A. D. Bridge's Sons, Hazardville	33.00	17
			East Berlin Mill Co., East Berlin	34.00	
			J. P. Barstow & Co., Norwich	35.00	
22575	Swift's Lowell Potato Manure	Swift's Lowell Fertilizer Co., Boston	T. H. Eldredge, Norwich	32.00	15
			Standard Feed Co., Bridgeport	30.00	
			Southington Lumber Co., Southington	32.00	
				31.25	
22754	N. E. Potato Fertilizer	New England Fertilizer Co., Boston	Rockville Milling Co., Rockville	31.00	15
			T. E. Green, Plainfield	31.00	
			T. B. Atwater, Plantsville	34.00	
				32.00	
22826	Wheeler's Bermuda Onion Grower	Amer. Agric. Chem. Co., New York City	W. Smith & Son., Canterbury	30.00	15
			T. W. Crane, Danbury	32.00	
				31.00	
22908	Grass and Oat Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	D. C. Burnham, Moodus	**30.00**	14
22651	E. Frank Coe's Celebrated Potato Fertilizer	Coe-Mortimer Co., New York City	J. G. Schwink, Meriden	30.00	15
			W. A. Burr, West Hartford	35.00	
				32.50	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.[1]							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
2827	85.2	....	0.64	1.56	2.20	**2.1**	6.19	2.61	1.50	10.30	**9.0**	8.80	**8.0**	2.10	2.10	**1.5**
2843	89.8	1.34	0.08	0.68	2.10	**1.7**	0.66	6.18	1.32	8.16	**8.0**	6.84	**6.0**	3.71	3.71	**3.0**
2823	93.5	....	0.12	1.02	1.14	**0.8**	3.62	1.63	1.54	6.79	**5.0**	5.25	**4.0**	8.62	8.62	**8.0**
2604	94.6	....	0.26	1.64	1.90	**1.7**	5.35	3.19	1.57	10.11	**9.0**	8.54	**8.0**	2.28	2.28	**2.0**
2648	95.9	....	0.22	1.58	1.80	**1.7**	6.14	3.68	1.57	11.39	**10.0**	9.82	**9.0**	2.92	2.92	**2.0**
2575	100.6	....	...	1.62	1.62	**1.6**	4.63	2.87	0.50	8.00	**8.0**	7.50	**7.0**	4.13	4.13	**4.0**
2754	101.8	....	0.10	1.55	1.65	**1.6**	4.50	3.03	0.70	8.23	**8.0**	7.53	**7.0**	4.27	4.27	**4.0**
2826	102.3	0.12	0.10	0.88	1.10	**0.8**	6.44	2.35	1.97	10.76	**9.0**	8.79	**8.0**	4.29	4.29	**4.0**
2908	105.3	....	0.12	1.00	1.12	**0.8**	5.52	2.58	1.56	9.66	**9.0**	8.10	**8.0**	4.18	4.18	**4.0**
2651	107.7	0.42	0.20	1.04	1.66	**1.7**	5.66	2.30	0.68	8.64	**9.0**	7.96	**8.0**	3.79	3.79	**4.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
2850	N. E. Corn and Grain Fertilizer	New England Fertilizer Co., Boston	Rockville Milling Co., Rockville	$29.00	$13.50
			T. E. Green, Plainfield	28.00	
				28.50	
2961	Grass and Oats	Amer. Agric. Chem. Co., New York City	F. M. Loomis, Granby	24.00	11.17
			G. A. Peckham, Suffield	24.00	
2838	E. F. Coe's N. E. Corn & Potato Fertilizer	Coe-Mortimer Co., New York City	W. E. Warner & Bro., Westville	28.00	11.61
			W. A. Burr, West Hartford	33.00	
				30.50	
2682	Fruit and Flower Developer	Germofert Mfg. Co., Charleston, S. C.	H. C. Sturgis,* Fairfield	....	23.26
2653	Potato Manure	Germofert Mfg. Co., Charleston, S. C.	H. C. Sturgis,* Fairfield	....	26.72
2683	Special Cotton Grower	Germofert Mfg. Co., Charleston, S. C.	H. C. Sturgis,* Fairfield	....	19.43
2914	Chittenden's Complete Grass Fertilizer	National Ferrilizer Co., New York City	J. M. Lasbury, Broad Brook	....	27.66
	Sampled by purchasers and others:		*Sent by*		
2338	H. G. Soluble Tobacco Manure	Rogers Mfg. Co., Rockfall	E. M. Griffin, R.F.D., Granby	43.50	38.45
2339†	Shay's Potato Manure	C. M. Shay Fertilizer Co., Groton	Thos. Griswold & Co., South Wethersfield	30.00	24.31
565	Potato "2"	Sanderson Fertilizer & Chem. Co., New Haven	James I. Webb, Hamden	35.00	28.26
711	Swift's Special Corn and Vegetable	Swift's Lowell Fertilizer Co., Boston	J. M. Taylor, Kensington, Conn.	36.00	25.04
352†	Shay's Potato Manure	C. M. Shay Fertilizer Co., Groton	E. H. McCall, Leonard's Bridge	....	27.28

* Purchaser. † See note page 73.

Analyses and Valuations—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.*							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
22850	111.1	....	0.08	1.38	1.46	**1.2**	5.69	1.79	0.81	8.29	**8.0**	7.48	**7.0**	2.20	2.20	**2.0**
22961	114.9	----	---	---	----	---	9.02	2.38	0.95	12.35	**12.0**	11.40	**11.0**	2.24	2.24	**2.0**
22838	162.7	0.15	0.16	0.64	0.95	**0.8**	4.81	2.41	0.46	7.68	**8.5**	7.22	**7.5**	2.85	2.85	**3.0**
22682	....	1.00	0.88	1.34	3.22	**3.3**	0.10	2.96	9.73	12.79	**10.0**	3.06	**4.3**	4.39	6.50	**6.0**
22653	....	1.66	0.90	2.03	4.59	**4.1**	0.24	2.03	8.35	10.62	**10.0**	2.27	**2.3**	0.76	5.63	**6.0**
22683	---	0.76	0.56	1.56	2.88	**2.5**	0.19	2.68	10.66	13.53	**12.0**	2.87	**2.0**	3.29	3.29	**3.0**
22914	---	0.15	1.64	2.93	4.72	**4.1**	5.23	1.67	1.13	8.03	**7.0**	6.90	**6.0**	5.47	5.47	**5.0**
22338	13.1	1.34	0.66	3.22	5.22	**5.0**	1.58	7.93	1.40	10.91	**8.0**	9.51	**6.0**	1.05	12.34	**11.0**
22339	23.4	0.48	0.12	2.85	3.45	**4.0**	2.96	4.51	0.97	8.44	**8.0**	7.47	....	6.55	6.55	**6.0**
22565	23.8	0.12	0.10	2.55	2.77	**3.0**	4.52	2.52	1.60	8.64	....	7.04	....	2.30	12.15	**12.0**
22711	43.8	0.74	0.08	2.46	3.28	**3.3**	6.62	1.74	1.04	9.40	**9.0**	8.36	**8.0**	7.10	7.10	**7.0**
23352	....	0.88	0.22	3.20	4.30	...	3.26	4.52	1.16	8.94	...	7.78	....	6.17	6.17	....

Special Tobacco Manures, claimed to contain potash, either wholly or in part in form of carbonate.

In the table below are given thirteen analyses of samples representing nine brands of this class of special manures.

All of these mixtures are claimed to contain potash, largely in form of carbonate, and "available" phosphoric acid. The trade name "available phosphoric acid" has already been discussed on page 35 of this report.

Regarding the guaranty of carbonate of potash, in many cases a chemical analysis cannot certainly prove or disprove the statement that potash is present in that form.

In making valuations for these fertilizers, potash sufficient to combine with the chlorine present is calculated as chloride; potash sufficient to combine with all the sulphuric acid present is cal-

TOBACCO FERTILIZERS CONTAINING CARBONATES.

Station No.	Name or Brand.	Manufacturer.	Dealer or Purchaser.
22702	Complete Tobacco Manure	Am'n Agric'l Chem'l Co., N. Y. City	F. S. Bidwell & Co., Wind. Locks
			J. & H. Woodford, Avon
			F. J. Hartz, R. D., S. Manchester
22739	*Bowker's Alkaline Tobacco Grower*	*Bowker Fertilizer Co., N. Y. City*	*A. D. Bridge's Sons, Hazardville*
			R. A. Hardin, Glastonbury
			Rose Arnold, Suffield
22737	*Bowker's Ash Elements*	" " " " "	*G. N. Thompson, Suffield*
22738	" " "	" " " " "	W. H. Prout, Suffield
22446	Mapes' Tobacco Starter Improved	Mapes F. & P.G. Co., N.Y. City	Mapes' Branch, Hartford
			Spencer Bros., Suffield
			F. S. Bidwell & Co., Wind. Locks
22844	Tobacco Ash Constituents	" " " " "	Spencer Bros., Suffield
			Mapes' Branch, Hartford
			M. H. Mallett, New Milford
22845	*Tobacco Manure, Wrapper Brand*	" " " " "	*Mapes' Branch, Hartford*
			J. H. Smith,* Windsor
			M. H. Mallett, New Milford
22847	Chittenden's Conn. Valley Tobacco Grower	National Fertilizer Co., N. Y. City	J. M. Lasbury, Broad Brook
			H. N. Fuller, Windsor Locks
22849	Chittenden's Tobacco Special with Carbonate	National Fertilizer Co., N. Y. City	J. M. Lasbury, Broad Brook
			L. O. Pomeroy, Suffield
22742	Complete Tobacco Fertilizer	Olds & Whipple, Hartford	F. F. Ford, Suffield
22743	" " "	" " " "	J. R. Gregg,* Suffield
22744	" " "	" " " "	Manufacturer
			E. T. Hulburt, Somers
			H. P. Lane, Suffield
			L. W. Allen, Suffield
			L. A. Kent, Suffield
			H. L. Spear, Suffield
21812	" " "	" " " "	J. R. Gregg,* Suffield

* Purchaser.

culated as sulphate, and any excess of potash remaining is then calculated as carbonate. We repeat that this does not necessarily conflict with the manufacturer's statement that a part or all of the potash was put into the mixture as high-grade carbonate. The matter has been fully discussed in previous reports.

GUARANTIES.

Five samples representing three brands have less than the guaranteed per cent. of potash. This deficiency is, however, in each case balanced as to money equivalent by an overrun of some other ingredient.

Samples Requiring Special Notice.

21812, Olds & Whipple's Complete Tobacco Fertilizer, of which the analysis is given below, was sent by J. R. Gregg, Suffield, and taken in March, 1908.

ANALYSES AND VALUATIONS.

Valuation per ton.	Nitrogen.					Phosphoric Acid.							Potash.					Chlorine.	Sulphuric acid.
	As Nitrates.	As Ammonia.	Organic.	Total. Found.	Total. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Calculated as chloride.	Calculated as sulphate.	Calculated as carbonate.	Water-soluble.	Guaranteed.		
.18	0.18	0.20	4.50	4.88	**4.6**	0.30	5.66	3.48	9.44	**4.0**	5.96	**8.0**	1.38	2.70	1.47	5.55	**5.5**	1.04	2.30
.10	0.18	0.06	3.85	4.09	**4.1**	0.58	5.94	5.26	11.78	**5.0**	6.52	**4.0**	0.90	1.63	2.85	5.38	**5.0**	0.68	1.39
.16	----	----	0.08	0.08	----	0.56	5.47	3.04	9.07	----	6.03	**6.0**	1.25	19.30	----	20.55	**15.0**	0.94	
.01	----	0.02	0.06	0.08	----	0.84	6.87	3.84	11.55	----	7.71	**6.0**	1.14	14.72	----	15.86	**15.0**	0.86	
.49	3.78	0.20	0.90	4.80	**4.1**	0.29	7.84	1.07	9.20	**8.0**	8.13	**8.0**	0.80	1.35	----	2.15	**1.0**	0.10	7.40
.96	0.35	0.02	0.66	1.03	**0.5**	0.11	2.53	3.67	6.31	**5.7**	2.64	----	1.20	3.30	8.48	12.98	**15.0**	0.90	2.81
.59	3.94	0.08	2.54	6.56	**6.2**	0.05	3.80	1.78	5.63	**4.5**	3.85	----	1.40	3.05	6.26	10.71	**10.5**	1.05	2.59
.00	0.30	0.12	4.54	4.96	**4.9**	0.25	3.71	1.02	4.98	**4.0**	3.96	----	0.51	1.40	5.82	7.73	**8.0**	0.38	1.19
.25	0.29	0.10	4.25	4.64	**4.5**	0.21	5.36	2.21	7.78	**4.0**	5.57	**8.0**	0.90	2.21	2.51	5.62	**5.5**	0.68	1.88
.92	0.96	0.06	3.92	4.94	**4.5**	0.17	3.35	0.38	3.90	----	3.52	**8.0**	1.05	1.26	3.04	5.35	**5.5**	0.79	1.07
.22	0.76	0.08	4.26	5.10	**4.5**	0.27	3.56	0.31	4.14	----	3.83	**8.0**	1.00	1.86	2.32	5.18	**5.5**	0.75	1.58
.35	0.73	0.07	4.20	5.00	**4.5**	0.05	3.70	0.28	4.03	----	3.75	**8.0**	0.90	1.25	3.11	5.26	**5.5**	0.68	1.06
.48	0.50	0.14	4.72	5.36	**4.5**	0.68	3.77	0.26	4.71	----	4.45	**8.0**	0.16	2.20	3.62	5.98	**5.5**	0.12	1.87

22907 is the same brand, sent by J. R. Gregg and sampled from stock of 1909.

22745 is Olds & Whipple's Complete Tobacco Fertilizer, *with extra lime,* and was taken by the station agent from stock of F. F. Ford, Suffield. The partial analyses of these two samples are:

	22907	22745
Nitrogen of nitrates	....	0.56
Nitrogen of ammonia	....	0.07
Nitrogen, organic	....	3.33
Nitrogen, total	4.70	3.96
Total phosphoric acid	....	2.98
Potash calculated as muriate	1.30	....
Potash calculated as sulphate	1.73	....
Potash calculated as carbonate	3.67	....
Potash, total	6.70	4.79

HOME MIXTURES.

In the following table are analyses of seventeen samples of mixtures, which were prepared on the farm or in a factory from a formula given by the purchaser and from the materials which are specified.

No direct comparison between the costs given in the table and the valuations is possible because the cost does not in all cases refer to retail cost per ton of the mixed and bagged goods.

Thus the costs of the mixtures from the Connecticut School for Boys, **22540** and **22541**, cover the unmixed chemicals bought in mixed car lots.

The cost of Mr. Treat's fertilizer, **22347**, covers that of the chemicals at the farm and of mixing.

The costs of **22611**, from the Norwich State Hospital, **22853**, **22854** and **22855**, from Mr. Fenn, and **23356** from Mr. Clark, are for goods mixed by a manufacturer according to buyers' formulas and delivered at the farm.

What is included in the cost of **22656** is not known.

The costs of **22712** and **22713** are for chemicals, delivered, unmixed.

23011 is a farm-made mixture of hen manure, night soil and raw phosphate with a few hundred pounds of cotton seed meal and a much larger amount of muriate of potash. It is designed to use on corn in the drill, being supplemented by a good dressing

of stable manure. The estimated cost takes account of cost of material and labor of mixing and screening the mixture so that it could be applied with a machine.

The average composition of these home mixtures is, nitrogen 4.06, phosphoric acid 9.59 and potash 9.75 per cent., being very considerably higher percentages of both nitrogen and potash than are found in average factory-mixed goods.

COTTON HULL ASHES.

Only four samples of this material have been analyzed this year.

22500. Sold by Olds & Whipple, Hartford, sampled and sent by O. J. Hazard, Suffield.

22413. Sold by Spencer Bros., Suffield, sampled and sent by them.

22722. Sold by Olds & Whipple, Hartford, sampled by station agent from stock of G. A. Peckham, Suffield.

22147. Sold by Spencer Bros., Suffield, sampled and sent by J. P. Spencer, Suffield.

ANALYSES OF COTTON HULL ASHES.

Station No.	22500	22413	22722	22147
Percentage amounts of				
Water-soluble potash found	26.47	23.66	22.60	12.96
Water-soluble potash guaranteed	25.00	25.00	22.00	14.50
Cost per ton	$51.00	50.87*	50.00	32.00
Water-soluble potash costs cents per lb.	8.6	9.6	9.8	10.2

In calculating the cost of potash per pound an allowance of $5.67 is made for the phosphoric acid contained in the ashes.

WOOD ASHES.

The table, page 110, gives analyses of ten samples of Canada ashes, oue of unknown origin and four from domestic manufacturing processes.

Canada ashes vary widely in composition.

The general average of the ten samples tested this year is

Water-soluble potash	4.35
Phosphoric acid	1.51
Lime	30.34
Magnesia	2.78

* $2.15 per unit of water-soluble potash.

Home Mixtures. Formulas,

Station No.	Made by or for	Formulas. Pounds per Ton of Mixture.										
		Nitrate of Soda.	Muriate of Potash.	Tankage	Acid Phosphate.	Kainit.	Double Sulphate of Potash.	Bone.	High Grade Sulphate of Potash.	Cotton Seed Meal.	Dried Blood.	Bone Black.
22540	Conn. School for Boys, Meriden (Grass)	500	250	500	400	350	---	---	---	---	---	---
22541	Conn. School for Boys, Meriden (Vegetables)	100	200	750	750	---	200	---	---	---	---	---
22347	Chas. R. Treat, Orange	240	360	700	700	---	---	---	---	---	---	---
22611	W. S. Palmer, Norwich State Hospital (Potatoes)	--	400	1104	496	---	---	---	---	---	---	---
22656	Robert B. Fowler, North Guilford	100	300	1000	600	---	---	---	---	---	---	---
22712	W. A. Simpson, Wallingford (Corn)	300	400	500	450	---	---	350	---	---	---	---
22713	W. A. Simpson, Wallingford (Potatoes)	369	---	369	492	---	---	---	400	370	---	---
22853	Dennis Fenn, Milford (No. 3)	100	200	800	---	---	---	200	---	---	100	600
22854	" " " (No. 2)	200	300	800	---	---	---	100	---	---	---	600
22855	" " " (No. 1)	200	200	800	---	---	---	200	---	---	---	600
23011	Fred Lyman, Manchester	---	---	---	---	---	---	---	---	---	---	---
23356	H. E. Clark, Middlebury (Top Dressing)	400	---	---	---	---	---	900	400	---	300	---
22654	S. L. Tuttle, Gaylord Farm Sanatorium, Wallingford	700	400	---	900	---	---	---	---	---	---	---
22375	H. B. Cooke, Georgetown	---	---	---	---	---	---	---	---	---	---	---
22781	R. J. McCleaver, Cheshire	---	---	---	---	---	---	---	---	---	---	---
22400	Andrew Ure, Highwood, No. 1	---	---	---	---	---	---	---	---	---	---	---
22401	Andrew Ure, Highwood, No. 2	---	---	---	---	---	---	---	---	---	---	---

The water-soluble potash is largely in form of carbonate, which in the pure state costs 7½ to 8 cents per pound, but for ordinary farm use is not more valuable than muriate costing 4¼ cents per pound.

The phosphoric acid may be reckoned at 3 cents.

Making this allowance and deducting from the average cost of the ashes, $13.00, leaves $7.40 as the cost of lime and magnesia, of which there is an average of 662 pounds in the ton. This is at the rate of $1.12 per 100 pounds of lime and magnesia, considerably more than the cost of these things in slaked lime.

ANALYSES AND VALUATIONS.

Station No.	Analyses. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.	Water-soluble Phosphoric Acid.	Citrate-soluble Phosphoric Acid.	Citrate-insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost and Valuation. Cost per ton.	Valuation per ton.
22540	3.76	0.08	1.36	5.20	2.40	3.09	0.50	5.99	9.47	$28.75*	$30.18
22541	0.88	0.08	1.96	2.92	4.94	4.41	1.06	10.41	8.30	24.25*	25.26
22347	1.54	0.32	2.01	3.87	4.24	4.38	1.18	9.80	10.31	28.60	29.50
22611	....	0.22	3.88	4.10	3.65	5.66	1.14	10.45	10.07	28.38	31.39
22656	0.87	0.10	2.79	3.76	4.42	6.42	2.21	13.05	7.11	28.40	28.76
22712	2.76	0.10	1.72	4.58	2.35	5.43	1.15	8.93	12.23	31.63	32.53
22713	2.56	0.08	2.58	5.22	3.14	2.18	0.46	5.78	9.36	33.60	31.71
22853	0.92	0.10	2.23	3.25	3.32	6.96	3.88	14.16	7.35	37.00	27.18
22854	1.43	0.10	2.17	3.70	3.87	4.83	2.24	10.94	9.91	38.50	29.11
22855	1.54	0.05	1.85	3.44	4.55	4.80	2.21	11.56	8.54	38.00	27.42
23011	0.02	0.24	0.64	0.90	0.31	6.23	4.71	11.25	14.89	20.00	22.47
23356	2.92	0.12	2.36	5.40	0.31	6.35	5.88	12.54	10.32	36.60	36.14
22654	5.20	0.04	....	5.24	5.51	1.28	0.19	6.98	10.55	....	31.66
22375	1.38	0.18	3.32	4.88	0.80	5.61	0.77	7.18	10.04	....	31.19
22781	1.94	0.08	2.56	4.58	1.10	4.80	0.37	6.27	7.16	....	26.88
22400	2.17	0.17	2.88	5.22	3.48	4.48	1.44	9.40	4.67	....	29.15
22401	....	0.10	2.69	2.79	3.31	4.12	1.01	8.44	15.55	....	29.71

* Wholesale.

The lime in ashes, however, is very fine and is in form of carbonate, facts which give it a somewhat higher agricultural value.

LIME-KILN ASHES.

These are ashes from wood used in making quicklime from limestone, which are unavoidably mixed with much lime dust.

21728 and **21729**, sent by R. H. Gardner, Cromwell; **22377**, sent by W. L. Mitchell, New Haven; **23400**, sent by H. B. Cooke, Georgetown.

WOOD ASHES. PERCENTAGE COMPOSITION.

Station No.	Dealer or Purchaser.	Sampled or Sent by	Total Potash.	Water-soluble Potash.	Phosphoric Acid.	Lime.	Magnesia.	Sand.	Charcoal.	Moisture.	Cost per ton.
	Bowker Fertilizer Co., New York City:										
22435	G. D. Hall, Wallingford	Station Agent	...	3.94	1.38	27.65	3.26	21.04	2.72	7.75	$12.50
22662	S. L. Tuttle, Wallingford	Station Agent	....	4.52	1.71	30.42	2.90	15.42	2.23	11.45	12.50
22903	Newell St. John, Simsbury	S. T. Welden, Simsbury	....	3.83	1.32	25.24	...	....	....	....	....
	John Joynt, Lucknow, Canada:										
22724	Olds & Whipple, Hartford	C. H. Eno, Simsbury	....	4.84	1.37	30.10	....	....	....	....	....
22553	Olds & Whipple, Hartford	J. C. Eddy, Simsbury	....	5.67	1.50	28.86	....	....	....	....	....
22761	F. S. Bidwell, Windsor Locks	Station Agent	4.68	4.03	1.41	28.92	2.10	9.70	2.50	21.62	15.00
22984	W. G. & F. Comstock, East Hartford	Purchaser	5.97	5.56	1.66	30.39	2.22	10.87	1.74	16.18	14.00
	F. R. Lalor, Dunville, Ont.:										
22390	L. C. Brainard, Thompsonville	Purchaser	....	2.68	1.20	31.37	3.54	13.46	5.43	18.30	12.50
22552	H. K. Brainard, Thompsonville	H. K. Brainard	....	3.71	1.64	33.64	....	....	....	....	....
	Charles Stevens, Napanee, Ont.:										
22397	M. Keeney, Somerville	Purchaser	....	4.71	1.94	36.86	2.46	6.63	1.66	10.15	12.00
21816	*J. E. Perkins, Suffield*	*The Bissell-Graves Co., Suffield*	....	4.69	2.44	33.75	3.26	8.32	4.03	7.53	12.00
	Ashes from Manufacturing Processes:										
23013	From Brick Yard of Brower & Best	J. H. Pease & Son, Thompsonville	....	1.16	1.80	40.28	5.15	19.13	0.62	0.14	....
22905	Foundry Ashes, No. 1	N. J. Robinson, Montowese	....	5.93	2.81	41.18	...	...	....	....	....
22906	Foundry Ashes, No. 2	N. J. Robinson, Montowese	...	3.62	2.19	43.44	....	...	....	....	....
23349	From Muffler of a brass factory	F. M. Peasley, Waterbury	....	4.59	2.43	39.80	4.16	3.27	10.90	1.98	....

ANALYSES.

	21728	21729	22377	23400
Total potash	3.93	0.14	.....	.....
Water-soluble potash	.....	.....	0.20	1.78
Lime	47.35	33.61	36.86	37.30
Magnesia	.....	.....	0.64	13.61
Phosphoric acid	2.17	0.41	0.38	.....
Moisture	0.26	18.80	10.54	.....
Sand	.....	.....	14.73	.....

LIME.

Bulletin 163, of this station, February, 1909, gave analyses of the limestones found in this State and in Massachusetts and of the various forms of agricultural lime made from them, with approximate wholesale prices and freight rates to Connecticut points. The following samples have been analyzed since that bulletin was issued.

Quicklime.

This is made from limestone by roasting to expel carbonic acid and water. As sold it contains more or less of these ingredients, which it absorbs again from the air.

22668, from Farnam's Cheshire Lime Co., Mass.; **22762**, from Buffalo Fertilizer Co., sent by C. M. Abbe, New Haven; **22543**, from Buffalo Fertilizer Co., sent by G. W. Adams, West Suffield; **23389**, bought of F. S. Bidwell & Co., Windsor Locks, sampled and sent by M. Keeney, Somerville.

ANALYSES.

	22668	22762	22543	23389
Lime	86.22	90.84	80.76	88.58
Magnesia	3.55	.....	.....	.....
Sand and iron oxide	1.21	.....	.....	.....
Cost per ton	$8.50*	6.00*	8.00	.....
Lime costs cents per 100 lbs.	49	33	49	.....

Slaked Lime.

This is understood to be made from quicklime by careful slaking with water so as to leave the product dry and fine.

Air-slaked lime results when quicklime exposed to the air absorbs both water and carbonic acid and crumbles to a powder.

* Car lots.

22391, from Farnam's Cheshire Lime Co., Mass., sampled and sent by James Price, Warehouse Point; **22542**, from the Vermont Lime Co., Greenfield, Mass., sampled and sent by A. F. Burnham, East Hartford; **23399**, sent by H. B. Cooke, Georgetown; **22578**, sent by C. J. Dewey, Buckland; **23340**, from Warner-Miller Co., New Haven, sent by E. A. Wilcox, Highwood.

23855, "Air-Slaked Lime" from Warner-Miller Co., New Haven, sampled and sent by D. L. Clarke & Son, Milford. It contains much unburned limestone.

ANALYSES.

	22391	22542	23399	22578	23340	23855
Lime	67.67	75.18	43.66	35.68	61.31	63.28
Magnesia	.....	.....	28.92	29.39	.....	.....
Moisture	.....	.....	.....	10.13	.....	.....
Insoluble	.....	9.30	.....	.....	.....	0.60
Cost per ton	$7.00*	8.00	5.00†	.....	.....	.....
Lime costs cents per 100 lbs.	52	53				

Carbonate of Lime.

22398 and **22399** are fine coral limes from Kissimmee, Fla., sent by F. O. Ives, West Cheshire; **22551** is marl from Caledonia Marl and Lime Co., Caledonia, N. Y., sent by L. C. Braïnard, Thompsonville; **22978** is carbonate of lime, sent by George A. Bush, Rahway, N. J.; **22904**, ground oyster shells, from Adamant Plaster Co., Fair Haven, sent by N. J. Robinson, Montowese; **23343**, shell lime from Adamant Plaster Co., sent by G. W. Thorpe, West Cheshire.

ANALYSES.

	22398	23399	22551	22978	22904	23343
Lime	54.52	44.69	49.93	35.69	25.24	41.99
Equivalent carbonate	97.26	79.73	88.26	63.73	45.07	74.98
Insoluble in acid	.....	.....	.....	4.87	.....	.....
Price per ton	.....	.....	$8.50	.....	.....	6.00

The agricultural value of any of these samples of lime depends, not only on the actual quantity of lime in it, but largely also on the *fineness of the product.* Unground oyster shells or limestone will lie for many years in the soil without going to

* Car lot. † Per ton at kiln, 7 miles distant.

pieces. The lime in them is compact and offers much less surface to the solvents of the soil and plant roots than the same amount of lime in finely powdered form.

MISCELLANEOUS FERTILIZERS.

SOOT.

23401. Soot from furnace flues, sent by N. S. Platt, New Haven, contained:

Nitrogen as ammonia	3.40 per cent.	
Nitrogen, organic	1.12	
Total nitrogen	4.52	
Water-soluble potash	0.71	
Moisture		9.63
Organic matter		45.56
Mineral matter		44.81
		100.00

A second sample, **23836**, contained 6.32 of nitrogen and 0.80 per cent. of potash.

The high percentages of nitrogen—higher than usually found in such material—explain its value as a fertilizer.

NITRATE OF POTASH.

22809. Sent by Mrs. A. Pouleur, Windsor, contained 46.84 per cent. of potash.

PULVERIZED SHEEP MANURE.

23355, from Natural Guano Co., Aurora, Ill., and **23354,** from Pulverized Sheep Manure Co., Chicago, both sent by the Elm City Nursery Co., New Haven; **22454,** Wizard Manure, from stock of Lightbourn & Pond, New Haven, and J. P. Barstow & Co., Norwich.

Analyses.

	23355	23354	22454
Nitrogen	2.52	2.58	2.50
Phosphoric acid	1.47	1.52	1.54
Potash	2.17	2.00	1.41

The value of this material is, in part, in the fine organic matter it contains, over 60 per cent., which adds to the humus of the soil.

TOBACCO STEMS AND TOBACCO DUST.

21787, sent by Ariel Mitchelson, Tariffville; **22126** and **22127**, tobacco dust, from Red Lion Tobacco Co., Red Lion, Pa., sent by R. E. Abbe, Thompsonville; **22419**, Kentucky stems, bought of Olds & Whipple, Hartford, sent by F. N. Buckland, Glastonbury; **22420**, seed stems, bought of cigar manufacturers and sent by F. N. Buckland; **22520**, bought of R. M. Goodrich, Hartford, sent by Geo. Rengerman, East Granby.

Analyses.

	21787	22126	22127	22419	22420	22520
Nitrogen as nitrates	....	0.86	0.39	0.40	0.47	0.66
Nitrogen as ammonia	....	0.14	0.10	0.27	0.43	0.23
Nitrogen, organic	1.63	1.47	1.93	1.07	1.61	1.20
Total nitrogen	1.63	2.47	2.42	1.74	2.51	2.09
Phosphoric acid	0.48	0.56	1.48	0.51	0.52	0.34
Potash	3.70	5.21	5.26	5.18	5.32	5.14
Moisture	17.50	....	....	30.87	17.89	26.64
Cost per ton	$10.40	10.50	....	13.00	12.00	12.00

SALT WASTE.

22045 and **22157** are wastes from powder works sent by Andrew Kingsbury, Rockville. One contained 0.26 per cent. of nitrogen as nitrates and 4.99 of potash; the other 0.29 per cent. of nitrogen and 1.25 of potash.

PLASTER.

22873. Nova Scotia Land Plaster from Adamant Plaster Co., New Haven, sent by A. C. Dickinson, Roxbury, contained 32.81 per cent. of lime, equivalent to 100 per cent. of pure hydrated plaster.

22324 is a precipitated plaster, a by-product of a chemical industry, containing phosphates, as the analysis shows. Sent by E. A. Jones, New Canaan. Made by Independent Baking Powder Co., Jersey City.

Analysis.

Water-soluble phosphoric acid	3.28	per cent.
Citrate-soluble phosphoric acid	1.57	"
Insoluble phosphoric acid	2.06	"
Total phosphoric acid	6.91	"
Lime	27.14	"

LAVA FERTILIZER.

23348. Mount Pelée Lava Fertilizer, from the American Health Association, Clifton, N. J., sent by W. H. Shumway, Berlin, who states that it is claimed to destroy all insects in the soil and keep plants in a healthy condition, free from disease. Cost, $15.00 per ton. It contains 0.86 per cent. of nitrogen, 0.27 per cent. of phosphoric acid and 0.07 per cent. of water-soluble potash; 40.31 per cent. of the material is insoluble in hydrochloric acid.

The following samples were sent without data as to source or price and have not any general interest or value, but are given here following our invariable rule to publish every analysis which is made.

21997, from S. C. Lewis, Stratford; **22010**, from H. C. Humphrey, N. Y.; **22808**, from Mrs. A. Poulcur, Windsor; **23360** and **23361**, from Harriet L. Merrow, Merrow; **23365**, from Miss Freda Gernon, New Milford.

ANALYSES.

	21997	22010	22808	23360	23361	23365
Nitrogen	1.19	4.64	....	0.95	2.20	0.30
Phosphoric acid	1.38	5.69	....	38.30	23.13	1.64
Potash	0.07	3.66	1.26	....	....	3.45

PEAT OR SWAMP MUCK.

22357. Black soil, having somewhat the appearance of muck, sent by B. W. Francis, West Cheshire. **22980**, Swamp Muck, sent by J. S. Dewey, Tariffville, contained 1.38 per cent. of nitrogen. **23385, 23386** and **23387**, sent by E. L. Conant, from swamps on his farm at New Canaan. **23385** was taken from a swamp of several acres in which the peat is from three to nine feet deep. The sample came from one foot below the surface, and **23386**, about two and one-half feet below the surface. Both had been dug three or four weeks and stored in a dry cellar. **23387** is from a neighboring swamp.

23391. Sent by C. W. Scranton, Madison, from a swamp on his farm. He is using this to compost with fish.

23392 and **23393** are dried peat, sold as filler or "conditioner" for commercial fertilizer. See page 75.

23394. Sent by Elters Button, Waterbury, from his swamp.

ANALYSES.

As received.

	22357	23385	23386	23387	23391	23392	23393	23394
Moisture	12.24	81.62	88.73	61.92	9.65	14.43	10.76	80.49
Organic and volatile	2.31	17.56	10.93	9.16	87.16	67.15	68.98	16.83
Mineral matter	85.45	0.82	0.34	28.92	3.19	18.42	20.26	2.68
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen total	....	0.36	0.18	0.38	1.46	2.81	3.04	0.64
of which								
as ammonia ...	....	0.03	0.03	0.02	0.16	0.10	0.16	....

Water-free.

	23385	23386	23387	23391	23392	23393	23394
Organic and volatile	95.52	96.99	24.05	96.48	78.47	77.29	86.26
Mineral matter	4.48	3.01	75.95	3.52	21.53	22.71	13.74
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.98	1.60	0.42	1.61	3.28	3.40	3.28

The nature of these peats is best compared by examining their composition in water-free condition.

Three of them, two from Mr. Conant's swamp and one from Mr. Scranton's, contain over 95 per cent. of vegetable matter or humus and these are the most valuable. Mr. Button's sample and the two peats sold as dryers would no doubt make excellent absorbents. Mr. Conant's third sample, **23387**, could probably not be handled to any profit. It contains too little vegetable matter and too much sand and soil.

The farm value of peat does not rest on its action as a fertilizer. It contains only very small amounts of either phosphoric acid or potash and while it may contain, in the water-free condition as the analyses show, from 0.40 to 3.40 per cent. of nitrogen, yet this nitrogen is in an insoluble and relatively inert condition. It is clear that this must be so. Peat is formed by the slow decay of vegetable matter under water and with a very limited supply of air. What is soluble and readily decomposable is decomposed and dissolved during the process, leaving as peat the residues which strongly resist any change.

Peat, nevertheless, has an agricultural value as an amendment depending, as Johnson has shown, on

1. Its remarkable power of absorbing and holding water both as a liquid and as vapor:

2. Its power of absorbing ammonia and other gases:

3. Its action in modifying the decay of organic (animal) and vegetable bodies:

4. Its effect in promoting the disintegration and solution of mineral matters in the soil:

5. Its influence on the temperature of the soil.

There is not space here to discuss these points in detail. A special bulletin on the subject is planned to call again to the attention of farmers the work done by Professor S. W. Johnson on the subject many years ago. It must suffice here to say that nothing makes so effective an absorbent in stables as dried or half-dried peat and that the experience of Connecticut farmers many years ago indicated that a compost of equal parts of peat and horse manure was equally as effective as the same weight of horse manure alone.

The great trouble is in getting peat dry enough where it is dug to make the necessary hauling not too expensive.

THE ASEXUAL TRANSMISSION OF VARIATIONS IN THE POTATO.

A following paper by Dr. East on the transmission of variations in the potato from one generation to another through the tubers, will not be generally distributed, because it is a technical discussion of research work, the details of which are of interest chiefly to students of the principles of heredity.

It will be included in the bound report which is supplied to all libraries, and copies will be sent on application to those who wish to have it.

The points established in this paper which are of practical interest and importance to potato growers and breeders may be briefly summarized as follows:

A study of variation in the tubers within a single variety of potatoes has shown three things of special interest to the commercial grower:

1. Variations in resistance to drought are not inherited. They are due to variations in different individuals in the time of setting tubers. If the tubers are very small at the time of the drought the plants will survive; if the tubers are more than half mature at that time, the vitality of the plant will have been used to such

an extent in their production that the plant is likely to die prematurely. Tubers from such plants have less vigor than those from plants that have matured normally.

2. Inherited variations sometimes take place in tuber reproduction, but they are rare and are simply losses of unimportant characters. No grower should expect, therefore, to obtain varieties by this means that will possess a greater commercial value than is possessed by the parent variety.

3. The numerous variations in yield, size, etc., that are always present in potato varieties are due to circumstances of environment and are not inherited. Continued selection of large tubers, therefore, will not increase the average size of the variety. On the other hand, if tubers which are diseased or immature are planted, the resulting plants have less vigor and the yield is thereby decreased.

THE TRANSMISSION OF VARIATIONS IN THE POTATO IN ASEXUAL REPRODUCTION.*

By EDWARD M. EAST.

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* The experimental work reported in this paper was conducted as a project under the federal appropriation for agricultural experiment stations, known as the Adams Fund. The field and laboratory work were done at the Connecticut Agricultural Experiment Station; the results were assembled at the Bussey Institution of Applied Biology of Harvard University.

Introduction.

In a previous paper (3), two series of data were presented, each giving the results from one year's selection of the extremes of a highly variable but accurately determined fluctuating character of the common potato, *Solanum tuberosum* L., when these extremes were reproduced asexually. The character under consideration was the total content of nitrogen determined by the Kjeldahl process. In one series, extremes averaging 14.07 per cent. and 8.75 per cent. in total nitrogenous matters when calculated to water-free basis, yielded crops averaging 14.70 per cent. and 12.59 per cent., respectively; in the other series, extremes averaging 18.06 per cent. and 13.37 per cent. in total nitrogenous matters, yielded crops averaging 10.90 per cent. and 9.29 per cent., respectively. These figures were due apparently to a correlation between mother and daughter tubers—if one may be allowed to use such terms—and yet the evidence even at that time did not appear to the writer to justify a conclusion that asexual fluctuations were inherited.

In the first place, the material at our disposal was a commercial stock, with nothing to guarantee its purity but our own judgment. Furthermore, it was slightly affected with scab and was treated with formalin for this disease. This treatment, poor soil and weather conditions, and the use of Paris green were so unfavorable to development that but few normal tubers resulted. This loss limited the data of the first series to one year, besides increasing the experimental error by making it impossible to compare tubers of the same state of maturity. The crop from the extremes of the second series, though much better than that of the first series, was small and could not be regarded as a normal crop of tubers. It was also a commercial stock. This experiment was terminated by a loss of the crop while it was in storage.

These statements show that it is impossible to conclude that our own observations included cases of definite inherited change among nitrogen fluctuations; on the other hand, the authenticity of certain cases reported by others, where permanent changes

such as loss of color have occurred in somatic tissue, cannot be doubted. Furthermore, in an exhaustive review of the work of previous investigators (3), the writer also found evidence that in rare instances heritable change in shape, size and chemical composition *may have occurred;* yet it was quite evident that in most of these cases the already complex question had been rendered more complex by refusing to distinguish between factors that belong essentially to the study of heredity, and factors that are primarily those of the physiology of development. In spite of the unconvincing nature of the published records concerning these other changes, there is no *a priori* reason to believe that the color variations noticed in commercial practice are the only transmissible variations that occur; and in any case the nature, frequency and causes of variations that do occur are entirely undetermined.

These reasons were of themselves sufficient to make it desirable to have the work repeated, with the experimental errors eliminated as far as possible; but there was still another reason for its repetition. Since the previous experimental work had been completed, Johannsen had published his classic monograph on "Erblichkeit in Populationen und in reinen Linien" (5), in which he concluded, first, that in a pure family line arising from a single self-fertilized seed, fluctuations are not inherited; second, that gametic changes may take place within a pure line, and when such a change occurs in an individual, its progeny at once forms a separate pure line or biotype. This piece of work was so excellent in all of its features that many biologists were at once convinced that his conclusions were correct. Other investigators have waited for corroborative evidence. Such evidence has recently been forthcoming. Jennings' (4) beautiful investigations concerning inheritance in protozoa lead him to exactly the same conclusions that Johannsen had obtained with beans as a material. Johannsen left asexual fluctuations out of consideration, although no essential distinction has yet been shown between them and fluctuations of a pure line propagated by sexual reproduction. Jennings, by his work on unicellular organisms, has proved the great similarity between inheritance in sexual pure lines and inheritance in asexual reproduction. In this paper is shown the similarity between the inheritance of fluctuations in asexual reproduction in multicellular organisms and that in the

classes treated by Johannsen and Jennings. Although the data are comparatively few, still they are sufficient, I think, to give a relatively high probability to this conclusion.

The Material and its Treatment.

In 1906 a number of both foreign and domestic varieties of potatoes was gathered together to observe the frequency with which differentiations occurred within a variety reproduced by tubers. In 1907 other varieties were added until they included over seven hundred named commercial varieties as well as a large number of seedlings. The sources of the varieties in Europe were Vilmorin, Andrieux & Cie. for France and Germany, and Sutton & Co. and Thos. Scarlett for England and Scotland. In the United States practically all of the introducers of commercial varieties contributed to the collection. Observations were made upon this stock in 1906, 1907, 1908 and 1909, although a number of varieties were discarded in 1908 because their characteristics were the same as those of other varieties. Among our unnamed seedlings was one of Early Rose, the seed from which it was grown being in all probability self-fertilized. It had no color either in the sprouts or in the skin; its shape was short oval round; its eyes deep. There were several excellent reasons why it would make a good subject for an investigation of the correlation between mother and daughter tubers when extreme fluctuations were selected. Having been raised from the seed in 1901, selected from a single hill in 1902, and carefully propagated by tubers for four years, there was no question but that we were dealing with a single variety wherein any variations present were produced asexually. In addition, there is reason to believe that the characters that it possessed are all recessive, as follows: white tubers, recessive to colored tubers; white flowers, recessive to colored flowers; deep eyes, recessive to normal eyes; roundness, recessive to elongation. Our reasons for this belief will be published in a separate paper. That the exact characters possessed by the variety are of some importance will be seen later when the evidence tending to show that bud variations are always losses of dominant characters, is produced.

Our material in 1906 for this portion of the investigation, then, consisted of about four bushels of tubers that had been

produced from a single tuber in 1902. From this stock one hundred and seventeen representative tubers with the following weight distribution were selected for analysis.

TABLE I.

DISTRIBUTION OF WEIGHTS OF TUBERS OF ORIGINAL STOCK, CROP OF 1906.

A. = 137 ± 2.06 S. D. = 32.97 ± 1.45 C. V. = 24.07% ± 1.21%

Class centers in grams	85	105	125	145	165	185	205	225	245	265	285
Frequency............	2	25	40	28	11	4	2	3	0	1	1

These tubers were sampled with a cork borer twelve millimeters in diameter, lengthwise but slightly to each side of the center—a method that previous experience had shown to be accurate (3). One of these samples was cut up and dried to constant weight at a temperature of 104° C., in a glycerol oven through which a current of hydrogen was passing. This gave the dry matter determination. The total nitrogen was determined by the regular Kjeldahl method as used by the Association of Official Agricultural Chemists. The total nitrogen was multiplied by the factor 5.5 and called total nitrogenous matters, although it is recognized that this factor may vary in a vegetable like the potato where the different nitrogen compounds are numerous. Yet the very fact that there are various compounds of nitrogen should give us a greater chance to determine whether variations in ability to assimilate nitrogen, constant in succeeding seasons, are produced with frequency in somatic cell division.

In discussing the data obtained, the simplest biometrical constants have been calculated, using the formulæ given by Davenport (1). The computations were all checked, but not in every case by two individuals. In each instance all of the figures have been used, although there are a few cases where strict mathematical treatment would call for the rejection of one or two extreme variates.

I believe that in cases where individual analysis is impossible, this modern statistical treatment is a great aid in concentrating the attention on the meaning of the figures *en masse*, yet there is no desire to argue that this treatment brings out more than can be seen by careful examination of the original data.

Inheritance of Fluctuations in Composition.

Results from the Analysis of the 1906 Crop.

The results of the analysis of the crop of 1906, from which were made our first selections for planting, are given in tables four to seven.

The classes in the frequency distribution of dry matter are centered on the even per cents. The mean is 18.15 ± .118 per cent., which is close to the average in water-free substance that analyses of a number of American varieties have shown. They are moderately variable, the coefficient of variation being 10.47 ± .463 per cent. Owing largely to the fact that in the highly variable character, weight, one or two individuals were found with a low per cent. of dry matter, the correlation between weight and dry matter is — .275 + .058. It is probable that the moderately wet period, during the time these tubers were maturing, is the cause of this, although it may very well be that there is generally a slight minus correlation between dry matter and weight.

The nitrogenous matters calculated to fresh material show a regular distribution with a mean of 1.92 ± .015 per cent. The standard deviation is .248 ± .011, and the coefficient of variation is 12.95 ± .580 per cent. When calculated to dry basis the mean is 10.75±.129 per cent.; the standard deviation is 2.08 ± .091; the coefficient of variation is 19.35 ± .740 per cent. There is no correlation between the weight of the tubers and the per cent. of nitrogenous matters, fresh basis; when calculated to dry basis, however, there is a slight correlation with weight, namely, .121 ± .061. As this correlation is only twice the probable error, we cannot be certain that it is a true value.

There is no doubt concerning the negative relationship between dry matter and nitrogenous matter, as the correlation coefficient is — .346 ± .055 when dealing with nitrogenous matters, fresh basis. The constant is naturally greatly increased when we use the dry matter as a basis for reducing the nitrogenous matters to comparable form. It then becomes — .758 ± .026. This relationship between dry matter and nitrogenous matters is not unexpected, for it is pretty definitely established that in all starch-storing plant parts, relatively more nitrogenous compounds are formed in the early stages of growth, and relatively more

starchy compounds in the final stages. This fact should be remembered when we consider correlation between mother and daughter tubers; for it follows that the relative percentage of dry matter is a better criterion of maturity than is the weight (although actual dry matter content varies widely in different seasons), and we should try as far as is possible to compare tubers of the same degree of maturity.

Results from Growing the Extreme Nitrogen Fluctuations of the 1906 Crop.

From the one hundred and seventeen tubers of the 1906 crop that had been analyzed, ten tubers high in nitrogenous matters and ten tubers low in nitrogenous matters were selected for planting in 1907. The basis upon which they were selected was their per cent. of nitrogen, calculated to fresh basis, for the determination of dry matter took about seven days and it was thought best to plant the tubers before its completion. Table two, however, shows that the calculation to dry basis in no case affected the classification of the individual.

TABLE II.

EXTREME NITROGEN FLUCTUATIONS PLANTED IN 1907.

High Nitrogen Extremes.				Low Nitrogen Extremes.			
Wt. grams.	Dry matter.	Nit. mat. fresh b.	Nit. mat. dry b.	Wt. grams.	Dry matter.	Nit. mat. fresh b.	Nit. mat. dry b.
119	18.02	2.48	13.76	136	17.32	1.53	8.83
165	16.40	2.34	14.27	158	18.11	1.45	8.01
145	14.75	2.36	16.00	203	16.01	1.42	8.87
118	17.98	2.37	13.18	129	18.72	1.30	6.95
137	16.40	2.49	15.12	187	18.30	1.63	8.91
146	16.13	2.42	15.00	151	19.09	1.52	7.96
138	16.83	2.38	14.14	106	18.90	1.50	7.94
106	18.81	2.36	12.50	114	19.85	1.61	8.11
110	15.35	2.36	15.37	103	19.26	1.61	8.36
113	17.74	2.28	12.85	120	21.66	1.43	6.60
Ave 130	16.84	2.38	14.22	141	18.72	1.50	8.05

Each of the ten tubers of each selection was cut in four pieces of as equal weight as possible. It has been found by many experiments, that if other conditions are equal, the yield increases directly with the size of the seed piece; therefore,

we endeavored to have our selected tubers and the planted pieces as uniform in size as possible. Notwithstanding the desire to obtain a normal crop, a sufficient number of tubers could not be analyzed to have the extremes especially uniform, nor were the planted pieces large enough to yield very good crops. References to table nineteen, however, will show that a fairly normal crop was obtained.

The tubers were planted on uniform soil in contiguous rows. They were allowed to develop naturally, the larvæ of the potato beetle being removed by hand and no sprays of any kind used. The season was somewhat dry during July and the first part of August, but there was a normal rainfall in the spring and in the latter part of the summer.

The chemical determinations upon the crop were made in the same manner as before. Where possible three tubers were analyzed from each hill. This would give twelve analyses of daughter tubers from each mother tuber. In a few cases, however, only one tuber was large enough for the analysis to have any value. The complete data are shown in tables twenty and twenty-one.

Table nine shows the correlation between weighted mothers and their daughter tubers in nitrogenous matters, dry basis, from the high nitrogen plot. The coefficient of correlation $-.387 \pm .054$ shows that there was no positive correlation between the deviations of mothers and daughters of this one selection; nor was there any positive correlation between mothers and daughters in the low nitrogen plot. For the fact that there is a minus correlation as high as $-.510 \pm .051$, I have no explanation. It is undoubtedly a physiological phenomenon, connected with the various states of maturity of different individuals. It illustrates how easily data from one season might show a positive correlation that would be mistaken for a proof of the inheritance of fluctuations. (See paper No. 3.)

Table eleven shows to better advantage that there was absolutely no inheritance of fluctuations. The weighted arithmetic means of the weighted mothers were 2.23 per cent. and 1.55 per cent. for the high and the low nitrogen plots, respectively, yet the frequency distribution of the daughters is so nearly the same as to be quite remarkable when the small number of individuals is considered. Both have the same mode at 2.5 per cent.

The means are 2.51 ± .028 per cent. and 2.51 ± .027 per cent. respectively. Two aberrant individuals raise the coefficient of variation in the high nitrogen plot to 17.41 ± .800, while in the low nitrogen plot it is 15.62 ± .771; but if these two individuals are discarded the variability is about the same.

The similarity of the progeny of the two plots is just as great when we examine the nitrogenous matter figures calculated to water-free material. The weighted arithmetic means of the weighted mothers of the high and of the low nitrogen plots are 14.11 ± .073 per cent. and 8.12 ± .015 per cent. respectively, yet the means of the daughters are 12.74 ± .171 per cent. and 12.81 ± .170 per cent. respectively.

In tables thirteen, fourteen and fifteen we have considered a possible inheritance of fluctuations in dry matter. Taking the high and low nitrogen plots separately, the coefficients of correlation between mothers and daughters are —.140 ± .062 and —.286 ± .063, respectively. There is no reason why we should not add the data from these two plots together, however, for they were grown side by side on the level land, and had the same treatment in each case. When this is done the coefficient of correlation is —.194 ± .045, which shows that there is no inheritance of fluctuations of dry matter.

Results from Growing the High Nitrogen Extremes from the High Nitrogen Plot of 1907 and the Low Extremes from the Low Nitrogen Plot of 1907.

From the analyzed tubers from the high nitrogen plot, the ten highest in nitrogenous matters, fresh basis, of those of normal development, were selected for planting in the high nitrogen plot of 1908. In like manner the ten tubers lowest in nitrogenous matters, fresh basis, of those of normal development in the low nitrogen plot, were selected for planting in the low nitrogen plot of 1908. Each tuber was divided into four nearly equal parts and planted as in 1907. The two selections were also planted in contiguous rows as before, although not on the soil formerly used.

A six weeks' drought during the growing season of this year killed some of the plants before tubers were set, and reduced the yield of all the plants. We were able to do some irrigation after the first two weeks of drought, but even this lack of water

limited the setting of the tubers, so that we were able to find but sixty-seven tubers large enough to be worth analyzing.

The complete data resulting from these analyses are recorded in tables twenty-two and twenty-three. In table sixteen we have the correlation between weighted mothers and daughters from both plots in per cent. dry matter, *viz.*, .228 ± .078. This result is the first positive correlation coefficient that we have found, and as it is small and the number of individuals is small, it can have but little weight in our general conclusions. The mean of the weighted mothers being 19.01 ± .100 per cent.,

TABLE III.

EXTREME NITROGEN FLUCTUATIONS PLANTED IN 1908.

High Nitrogen Extremes.				Low Nitrogen Extremes.			
Wt., grams.	Dry matter.	Nit. mat. fresh b.	Nit. mat. dry b.	Wt., grams.	Dry matter.	Nit. mat. fresh b.	Nit. mat. dry b.
90	16.60	3.29	19.82	77	19.57	2.03	10.37
114	17.60	2.91	16.53	109	19.08	1.87	9.80
68	20.50	3.10	15.12	88	21.43	2.02	9.43
94	18.70	2.87	15.35	88	20.62	1.97	9.55
79	19.30	3.19	16.53	105	18.28	2.06	11.27
74	18.80	3.30	17.55	114	19.81	2.14	10.80
67	21.10	3.17	15.02	118	18.55	2.14	11.53
99	17.20	3.14	18.25	168	19.80	2.08	10.50
72	18.20	2.97	16.32	92	19.28	2.18	11.30
89	16.90	3.29	19.47	92	18.79	2.21	11.76
Ave. 85	18.49	3.12	17.00	105	19.52	2.07	10.63

and that of the daughters being only 12.19 ± .129 per cent., shows that the tubers have not obtained their normal development and from this their normal dry matter. This fact is shown also by their small size (tables twenty-two and twenty-three). Since we have seen before that much more of the total amount of nitrogenous matters contained in each tuber is formed early in the season than is stored later, we can place much more dependence in the total nitrogen determination than in the dry matter determination. The abnormality of the dry matter, however, affects the reduction of the percentage of the nitrogenous matters to water-free basis.

Although the number of individuals analyzed in 1908 was

considered in the form in which they were brought together in tables seventeen and eighteen, should carry considerable weight. We are dealing, in the crop from each plot, with extremes that have been selected for two years to try to force them apart in their composition. We are really dealing, then, with a very large population from which the middle, *i. e.*, the mediocre individuals have been dropped out. If there is the slightest amount of inheritance of these deviations, the weighted arithmetic mean of the high nitrogen plot should he higher than the weighted arithmetic mean of the low nitrogen plot. But this is not the case: the means are 2.32 ± .028 per cent, and 2.48 ± .033 per cent., respectively, the nitrogenous matters, fresh basis, even averaging somewhat higher in the low nitrogen plot. The percentage of variation is also about the same in each plot, 10.26 ± .860 per cent. and 11.24 ± .942 per cent. When reduced to the basis of water-free material by use of the aberrant dry matters, the mean of the high nitrogen plot, 20.6 ± .459 per cent., is slightly higher than that of the low nitrogen plot, 19.3 ± .358 per cent., but this difference is within the limit of probable errors.

Table nineteen may be mentioned here. It was added to show the total crops obtained from each tuber planted. It sustains former conclusions by several investigators, that there is a positive correlation between weight of seed tubers and size of crop.

We may conclude from this part of the investigation that neither the relative content of dry matter nor that of the nitrogenous matters of the potato can be changed by the selection of fluctuations and their subsequent asexual reproduction.

Note.—The crop of 1908 was so much reduced by the unfavorable season that it seemed scarcely worth while to continue the experiment with such seed; the selections were made as usual, however, and were planted in 1909. As was expected, the plants had no vitality and the crop of 1909 was discarded.

Inheritance of Fluctuations in Yielding Power.

Many experiments have been conducted to find out whether the yielding power of a variety of potatoes can be increased by selection from the highest yielding plants. The writer previously has reviewed the evidence (3) and shown that it is inconclusive. In a more recent investigation, that of Waid (6 and

7) of the Ohio Agricultural Experiment Station, a positive conclusion is reached. This conclusion seems to have enlisted the support of as eminent a student of genetics as Webber (8). There are a number of points, however, upon which Waid's work needs explanation. In the first place, he seems to have taken no account of the well-known fact, that if other conditions are equal, the yield increases directly with the size of the seed piece, owing to the greater amount of stored food upon which the young plant may draw. In the second place, Waid apparently used a commercial stock, and was not absolutely certain that he was dealing with a single variety. Many varieties now upon the market are exactly alike in external characteristics and are often mixed by seedsmen, although from having originated from separate seedlings and different parents, their yielding powers may be quite different. Furthermore, we know that stock of the same asexually produced variety may be quite different in its yielding power when grown under different soil and climatic conditions. This fact, which may account for differences in Waid's own results in the second and third seasons, as well as the differences in yield in his first selections in his commercial stock, is purely a physiological phenomenon of development and should be separated from the question of inheritance which is under discussion. If actual permanent differences in yielding power are produced by asexual variation in normal, mature, healthy tubers, the yielding power of a variety could be raised by selection. We know that deterioration takes place when immature or diseased tubers are used for reproduction; this is not due to the inheritance of a variation, but to the effect upon the vitality of the plant of starting it from a diseased tuber, or from a tuber which from immaturity has not a sufficient amount of nutriment stored up for the use of the young plant. There is no question here of selection in the ordinary sense, but of selection similar to the separation of heavy from light tobacco seed, because the former gives healthier plants although their hereditary characters are the same as those of the plants from the light seed. In the same way, with potatoes it is a question of having external conditions favorable for a mature crop free from disease, and not of selection of high yielding plants to increase the yield through a variation actually transmitted to the descendants of a varying somatic cell.

In 1906 we had in stock a supply of the well-known variety Rural New Yorker No. 2, which had been grown from a single hill in 1904. A selection of tubers from the five best yielding hills was planted in 1907, and compared with five normal hills producing only one-half as much. The five best yielding hills averaged 1,200 grams of tubers per hill, with an average set of eight tubers. The check hills averaged 600 grams, with a set of four tubers each. Ten hills were planted in each case, two tubers being planted from each hill. In every case pieces of about the same weight were planted. The yield from the high yielding selections was at the rate of 101 bushels per acre; while the yield from the check hills was at the rate of 128 bushels per acre.

In 1908, four tubers from each of the best two hills were again planted from the progeny of Selection A, the high yielding hills of 1906. These were checked with four tubers from two normal, but not high yielding hills of Selection B. This year the selected hills of Selection A average 1,000 grams per hill, while the selected hills from Selection B averaged 600 grams per hill. As above, tubers of the same size were planted in each case. Selection A yielded at the rate of 96 bushels per acre; Selection B yielded at the rate of 90 bushels per acre.

In 1909 the best two hills, averaging 1,100 grams, from Selection A, were again planted, and compared with the two normal hills of Selection B, averaging 700 grams per hill. The yield from Selection A was at the rate of 115 bushels per acre; while the yield from Selection B was at the rate of 120 bushels per acre, although the four hills were planted with equal-sized tubers as before.

It is admitted that these plots were very small and that the thirty hills of the 1906 crop forming the basis of selection do not allow the selection of wide extremes, yet I have succeeded a number of times in isolating strains of maize of different yielding power with about the same number of individuals as a basis. In maize, where there is a constant state of hybridation between natural biotypes, such isolation is possible; in asexual reproduction in the potato, I do not believe it to be a common possibility. I admit, however, that in rare cases it is not without the bounds of probability that changes occur in the somatic cells whereby real differences in inherent yielding ability are produced. It

may be that the results of Waid mentioned above were from one of these instances. Attention has been called to other possible explanations of them, because it seems desirable that great caution should be used in recommending asexual selection to commercial growers as a means of actual improvement of the crop, in view of the facts, first, that out of many investigations on the point no indisputable evidence of improvement has been reported, and second, that even the questionable instances of positive results are extremely rare.

Inheritance of Power of Resisting Inhospitable Environment.

A number of investigators have noticed individual plants within a variety that have remained green after the majority had died. In several cases these instances have been cited as due to disease resistance in the plants in question, the disease that they were supposed to have resisted being the leaf spot disease caused by the fungus *Alternaria solani,* commonly known as early blight. In no case have I found it recorded that the dead plants were given a *post-mortem* and the cause of death actually determined as early blight. Since they have died and in the process have had spotted leaves, it has merely been taken for granted that early blight was the cause of death. Several investigators have selected seed tubers from the dead plants and also from those remaining alive, and from a comparison of their respective progenies, have made the claim that the latter transmitted the power of disease resistance.

The writer kept over 700 varieties under observation in 1907 with the idea of obtaining data upon the question. There was very little injury due to fungi during the year. Dr. G. P. Clinton did not find late blight, *Phytophthora infestans,* until just before the first frost, and then found only a few affected plants. It is possible that early blight was present during the summer, but the important immediate cause of death was the physiological trouble, tip-burn. This trouble is present every season, although more in evidence whenever there is a long drought. It starts at the large water-pore at the end of the leaf and continues over the surface until the leaf gradually dries up and dies. I examined a large number of plants of different varieties

and found that the rate at which the plant succumbed to tip-burn under given weather conditions depended almost entirely upon the stage of growth of the plant. Plants that had not begun to set tubers withstood long periods of drought. The resistance to drought decreased slowly until the tubers reached about 75 grams in weight, and then decreased very rapidly, so that plants with tubers two-thirds their normal size could withstand very little dry weather. When the largest of the tubers were removed from a plant where they were one-quarter normal size, the plants continued to withstand the drought better than other plants of the same variety where all the metabolic activities were being used to store up food in tubers. Of course mutilations such as punctures of flea beetles contributed to the susceptibility of the plants in question and only varieties with about the same amount of injury from this source were taken into consideration.

In the following varieties plants were found that died at least one month before others: Magnum, Warrior, Gov. Folk, Up-to-date, Table Talk, Solief and Gem of Aroostook. From each of these varieties, tubers of the short-lived and the long-lived plants were selected as seed tubers for the next season. Since the tubers from the short-lived plants were not mature, it would not have been a strictly fair comparison to have selected large tubers from the long-lived plants, even though the latter were cut to the same sized seed pieces as the former. For this reason whole tubers of the same size were selected in each case. In the resulting crop there were two cases in which plants among the progeny of the long-lived plants were themselves long-lived, and two cases where plants from the short-lived plants were long-lived; but in each case the remaining plants of both selections died at about the same time.

It must be mentioned, however, that another variety, Mills Banner, was among those from which tubers of long-lived and short-lived plants were grown. In this case all of the progeny of Plant A, the long-lived plant, were themselves long-lived, while all of the progeny of Plant B, the short-lived plant, were short-lived. Owing to this fact, a very careful examination of the progeny of each plant was made, and led to the discovery that all of the progeny of Plant A had pink sprouts, while all of the crop from Plant B had white sprouts. Either a bud variation had taken place or an accidental mixing of two varieties had

As a result of these experiments I would not go so far as to say that variations in power of resisting physiological or fungous diseases *do not occur* in asexual reproduction, but I do believe that the relative probability that the commercial grower will obtain disease-resisting varieties by this means is negligible. In most cases of so-called disease resistance within the variety, non-infection would be the proper term; and when there is apparently a marked difference in vitality, it is due to differences in maturity at the time the plants are called upon to withstand inhospitable environmental conditions. The fact that seed pieces planted at the same time produce plants that are at different stages of maturity at the same time, has nothing to do with the question under discussion. It may be due to any of several causes, such as differences in size of seed piece, varying amounts of soil fertility, injury of the buds of the subterranean stem, or removal of young tubers by rodents.

Inheritance of Variations Generally Classed as Bud Variations.

In a former paper (2), the following statement was made in regard to bud variation in the potato:

"In the potato bud variation has almost always been confined to color variations. Mr. A. W. Sutton (in a personal communication) makes this statement: 'I have no hesitation in affirming that there is no potato in commerce to-day in England, and I might say in Europe, which owes its origin as a distinct potato to bud variation in any form whatever.' After a wide inquiry in the United States, I believe that the statement is also true for this country. Mr. Sutton cites 'Forty-fold,' 'Beauty of Hebron,' and 'Paulsen's Blue Giant,' as having varied from colored skins to white. Mr. P. deVilmorin, also, has kindly given me two instances of the same sort. In this country I have seen three color variations, and collected evidence concerning five others—apparently authentic—that are losses of color characters. But two exceptions to the rule have appeared. Mr. Sutton reports that 'Rector of Woodstock,' which was originally white, has produced a purple variegated skin. In this case, however, it is unknown whether the parent tuber possessed the power of forming the purple dye, as is indicated in some of our whit

"There has appeared a similar variation also in the 'White Pearl,' reported to me by Prof. E. R. Bennett. This potato, white in color with pink sprouts, appears to have produced a purple spotted variety. Old potato growers, however, say that the parent of the 'White Pearl' had a purple skin."

The authentic evidence, that we had at that time, included but one case where a colorless variety had sported to a colored variety—the Rector of Woodstock—and even this case is doubtful from our meager knowledge of the parent variety. Although my personal knowledge has increased materially since the above was published, I have no reason to change the opinion then expressed, that practically all, if not quite all bud variations are losses of a dominant or an epistatic character allowing the appearance of a recessive or a hypostatic character. A detailed statement of the cases that have come under my observation follows.

Changes in Color.

La Bretonne, Early Sunrise, Bole Zoegling and Seedling No. 60, all pink or red varieties, have produced white variations that were constant the next season. The change affected only the color of the tuber. Seedling No. 853 in its third year from seed produced one white tuber, the remaining tubers being the normal purple. This variation came true the next year.

Several apparent changes from white to colored tubers appeared, but the changes were not constant. Arabella, Solief and Crown Jewel, all varieties in which the sprouts have a slight pink color, produced individual tubers with a marked pink coloration. The next season, however, the tubers produced by them were exactly like those of the normal variety. In 1907 tubers of the varieties Prizetaker and Aradaras appeared with deep red protuberances (Plate III). Unfortunately, neither of these protuberances produced plants. Even had the variation been constant, however, it could not have been said that color was produced by an absolutely colorless variety, for in each case the normal tubers have some pink in their sprouts.

Changes in Shape.

Four marked changes in shape from long to round tubers have been observed. In the varieties Silver Hill and Early Ohio these changes were permanent. A close observer could recognize

other characteristics of the parent varieties in the round tubers, but in each case the change from a long-tubered variety to a round-tubered variety was quite distinct. Two other long-tubered varieties, White Beauty and Seedling No. 842, also produced round variations, but in these two cases the progeny were all long like their parent varieties. Two other variations were noted where the change was not permanent. State of Maine and Orphan, two oval varieties, produced single plants upon which all of the tubers were very much elongated, approaching the Lady Finger in shape. These tubers were grown the next year in comparison with normal tubers of the same variety. In both cases the crops were exactly like those regularly produced by the varieties.

Changes from Shallow to Deep Eyes.

Four permanent bud variations were observed in another chapter which, though similar to change in form, evidently affects a separately inherited factor. Potato varieties to have a commercial value must have rather shallow eyes, otherwise too much substance will be lost in peeling; but sometimes a bud variation occurs in which the tuber appears as if it had had wires attached to all of its eyes whereby the latter were drawn in toward the center of the tuber. This gives the tuber an irregular appearance very well illustrated in Plate II. Such variations appeared in varieties State of Maine, Early Ohio, Endurance and Seedling No. 843. In each case they were permanent.

Change in Habit of Growth of Tubers.

A peculiar change appeared in the variety called Pennsylvania, which is illustrated in Plate III. It consists of a prolongation of the so-called bud end of the tuber into a stem which bears another tuber at its extremity. On occasional tubers in other varieties this phenomenon has occurred, but only in this case has it been permanent and characteristic of the variety, although these abnormal tubers have been planted a number of times. I have heard the matter mentioned by old potato growers, not as a bud variation but as an indication that the variety has become reduced in vigor. The plants produced from these abnormal tubers in the Pennsylvania variety were all abnormal. Of course some tubers were formed in the regular manner on

each plant, but each plant had at least one tuber showing the aberrant form. We have no evidence concerning the inheritance of this last variation in sexual reproduction, but the changes affecting the other three characters are changes from dominant to recessive. This does not prove that the reverse changes never occur, but if no such changes have been recorded by all of the numerous observers of this widely grown crop, they must be rare indeed.

Attempts to Produce Variations through Grafts.

A brief account of some experiments with grafted tubers is given here because it is thought that they have some interest in connection with asexual variation, even though the results are negative. The material used was taken from fourteen different varieties, giving several chances to find varieties that would graft upon each other. Five varieties with white skin were utilized, *viz.*, Early Carman, Moneymaker, Thorburn (white), Snowball and Clyde; in addition, Prizetaker, a variety with a white skin but with light pink sprouts, was included. The red-skinned varieties in use were Early Sunrise, Old Hemlock and Stray Beauty; while Sturtevant, Venezuela and S. Commersonii violet (Labergerie) comprised the purple-skinned varieties.

Over one hundred attempts were made to make grafts between buds of colored and white tubers. In each case we endeavored to cut the bud in half at its apical point and to graft half buds from colored and colorless tubers. Various methods of technique were tried, winding with soft twine being about as successful as the use of grafting wax. The tubers were placed where they could grow in the laboratory, and were carefully examined each day. In every grafted sprout the growing tissue of either one or the other of the two plants gained the ascendancy and in three or four days the upper point of the other sprout was left far behind. This portion of the sprout, while it did not dry up and die, did not increase in size, and was soon almost surrounded hy the growing tissue of the other part of the sprout. It was quite evident that the new plant was always formed from the growing tissue of *one* variety.

The second experiment consisted in inserting a bud cut from a tuber of nto a

hole of the same size in a colored tuber, or *vice versa*. The other buds of the tuber were cut away and their places filled with grafting wax. Sixty of these various combinations were made and planted. When the young stems were two or three inches above the ground they were all dug up and examined. Seventy-five per cent. of the tubers had developed adventitious buds from the surrounding tuber. These sprouts were removed and the tubers replanted.

Twenty-three plants produced tubers, but absolutely no influence of the stock could be seen. It seems reasonable to suppose that a migrating character like color, when so placed that it could be utilized by the young stem, would be carried into the growing tissue and again appear in the progeny, but this was not the case. There appeared to be no influence on the scion either as a direct addition, or as a loss of a color character, or as a separate variation produced by influence of the stock. From this experience we suspect that many of the so-called graft-hybrids in the potato were merely plants exactly like the stock, produced from it by unnoted adventitious buds.

General Conclusions.

The investigations reported in the foregoing pages suggest very forcibly that the behavior of variations reproduced by budding is in many ways essentially like that of variations coming from seed. The inherited variations that were found have all but one concerned characters that mendelize in sexual reproduction, and as there is no evidence upon the inheritance of the one exception, it may be left out of consideration. Five cases of loss of color, two changes from long to round shape and four changes from shallow to deep eyes have come under our observation, all of which are common differences between seedlings out of a selfed fruit from our much crossed commercial varieties. *If the causes and mechanism of production of both* sexual and asexual variations are not similar or identical, it is very peculiar that no distinction between the two classes has been found. It is true that all of the asexual variations have been losses of characters, while in sexual reproduction the formation of new characters occurs. If no progressive variations occur in asexual reproduction, it must mean that there is a mechanical drawback to their production that sexual reproduction

does not share; but the fact that they have not come under our observation simply proves them to be much rarer than the retrogressive variations. The last explanation parallels sexual variation, where retrogressive changes are very much more common than progressive changes, yet it seems important to call attention to a possible difference in the mechanical origin of sexual and asexual variations.

Any discussion regarding the mechanism of the production of variations is of course pure speculation, yet one cannot help feeling that the production asexually of changes that mendelize, throws some light on the subject. It follows that segregation may occur in the somatic cells, and that by division of one of these cells a line of descendants originates lacking a Mendelian character that is present in the parent cell. This fact does not develop anything new in regard to the relative importance of the chromosomes and the cytoplasm as bearers of hereditary characters, but it certainly seems to show that Mendelian segregation *is not limited to the reduction division in the maturation of sexual cells.*

Considering the amount of material under observation, the occurrence of twelve inherited variations is an unexpectedly high rate of frequency. Of course the careful scrutiny of the crop in every hill would partially account for a higher frequency than is observed by commercial growers. It might also be accounted for by the large number of colored varieties in our collection, as colored varieties form a very small proportion of the crop in the United States. Compared with an anemophilous crop like maize the per cent. of varying plants is very small, but compared with a close-fertilized crop like tobacco the difference in numbers, while still considerably less, is not remarkable. But should unobserved changes have occurred in ten times the quantity observed, there is no reason to recommend asexual selection as a commercial means of actual improvement. No changes that are of commercial value have yet been found, and, if they occur, they are rare indeed. The commercial grower would be swamped in trying out the numerous fluctuating variations that are not inherited, with scant possibility of ever finding a favorable inherited variation. Mature tubers free from disease should always be planted, but this precaution is made simply to give the young plants a normal start in life, and does not change their hereditary characters.

The classification of all of the permanent bud variations as losses of characters shows the investigation of the possible inheritance of fluctuations in composition in a new light. Since the variety used in the investigation was recessive in all the characters whose behavior in sexual reproduction is known, less probability exists that an inherited change might take place that would obscure the results on the class of variations immediately concerned. This being the case, we may feel some confidence in a conclusion that fluctuations (variations due to surrounding conditions) are not inherited. Furthermore, there is little doubt but that the cases of so-called disease resistance should be classed as noninherited fluctuations due to various physiological causes.

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TABLE IV.

Correlation between per cent. Dry Matter and Weight of Tubers in Grams, Crop of 1906.

Per cent. Dry Matter (columns); Weight in Grams (rows)

Weight in Grams	14	15	16	17	18	19	20	21	22	23	
85						1				1	2
105	2	2	1	5	4	4	6	1			25
125		1		5	11	10	6	4	3		40
145	1	1	4	6	6	5	3	2			28
165		1	3	3	3		1				11
185			1	1	1	1					4
205			1	1							2
225	1			1					1		3
245											0
265					1						1
285	1										1
	5	5	10	22	26	21	16	7	4	1	117

Per cent. Dry Matter.

A. = 18.15 ± .118

S. D. = 1.90 ± .083

C. V. = 10.47 ± .463

Weight in Grams.

A. = 137 ± 2.06

S. D. = 32.97 ± 1.453

C. V. = 24.07 ± 1.21

Coef. Cor. —.275 ± .058

TABLE V.

Correlation between Weight in Grams and per cent. Nitrogenous Matters, fresh Basis, Crop of 1906.

Weight in Grams (columns); Nitrogenous Matters, fresh basis (rows)

Nitrogenous Matters, fresh basis	85	105	125	145	165	185	205	225	245	265	285	
1.3			1									1
1.5		1	1	2	1		1					6
1.7	1	4	17	7	5	2		1				37
1.9	1	5	10	9	4	2	1	1		1		34
2.1		10	6	4								20
2.3		5	4	4	1			1			1	16
2.5			1	2								3
	2	25	40	28	11	4	2	3	0	1	1	117

Weight in Grams.

A. = 137 ± 2.06

S. D. = 32.97 ± 1.453

Nitrogenous Matters, fresh basis.

A. = 1.915 ± .015

S. D. = .248 ± .011

95 ± .580

TABLE VI.

CORRELATION BETWEEN WEIGHT IN GRAMS AND PER CENT. NITROGENOUS MATTERS, DRY BASIS, CROP OF 1906.

Nitrogenous Matters, dry basis. \ Weight in Grams.	85	105	125	145	165	185	205	225	245	265	285	
7	1		2									3
8		4	3	1	1							9
9		1	10	5	1	1	1	1				20
10	1	6	14	8	5	2				1		37
11		2	3	5	1			1				12
12		3	4		2	1	1					11
13		6	2	3								11
14			1	3	1							5
15		2	1	2							1	6
16		1		1				1				3
	2	25	40	28	11	4	2	3	0	1	1	117

Weight in Grams.

A. = 137 ± 2.06
S. D. = 32.97 ± 1.453
C. V. = 24.07 ± 1.21

Nitrogenous Matters, dry basis.

A. = 10.75 ± .129
S. D. = 2.08 ± .091
C. V. = 19.35 ± .740

Coef. Cor. = .121 ± .061

TABLE VII.

CORRELATION BETWEEN PER CENT. DRY MATTER AND PER CENT. NITROGENOUS MATTERS, FRESH BASIS, CROP OF 1906.

Nitrogenous Matters, fresh basis. \ Dry Matter.	14	15	16	17	18	19	20	21	22	23	
1.3						1					1
1.5			1	1	1	2			1		6
1.7				12	10	5	6	2	1	1	37
1.9	1	1	3	1	8	7	7	5	1		34
2.1	1	1	2	6	2	4	3		1		20
2.3	3	3	2	2	4	2					16
2.5			2		1						3
	5	5	10	22	26	21	16	7	4	1	117

Per cent. Dry Matter.

A. = 18.15 ± .118
S. D. = 1.90 ± .083
C. V. = 10.47 ± .463

Per cent. Nitrogenous Matters, fresh basis.

A. = 1.915 ± .015
S. D. = .248 ± .011
C. V. = 12.95 ± .580

Coef. Cor. —.346 ± .055

TABLE VIII.

CORRELATION BETWEEN PER CENT. DRY MATTER AND PER CENT. NITROGENOUS MATTERS, DRY BASIS, CROP OF 1906.

Dry Matter.

Nitrogenous Matters, dry basis.	14	15	16	17	18	19	20	21	22	23	
7						1			1	1	3
8					1	3	2	2	1		9
9			1	1	3	4	5	4	2		20
10				10	11	7	8	1			37
11			1	2	4	4	1				12
12		1	2	3	3	2					11
13		1	2	5	3						11
14	1		2	1	1						5
15	2	2	2								6
16	2	1									3
	5	5	10	22	26	21	16	7	4	1	117

Per cent. Dry Matter.

A. = 18.15 ± .118
S. D. = 1.90 ± .083
C. V. = 10.47 ± .463

Per cent. Nitrogenous Matters, dry basis.

A. = 10.75 ± .129
S. D. = 2.08 ± .091
C. V. = 19.35 ± .740

Coef. Cor. —.758 ± .026

TABLE IX.

CORRELATION IN PER CENT. NITROGENOUS MATTERS, DRY BASIS, BETWEEN MOTHERS SELECTED FOR HIGH NITROGEN, AND DAUGHTERS CROP OF 1907.

Per cent. Mothers.

Per cent. Daughters.	12	13	14	15	16	
8			2			2
9			4	5		9
10		1	9	3	1	14
11			3	7	4	14
12		2	6	7	4	19
13	4	3	7	5	2	21
14	3	2	1	1		7
15	5	3	1	1		10
16		2	1	2		5
17		2		2	1	5
18		2	1			3
19		1				1
20		2				2
21						0
22		1				1
	12	21	35	33	12	113

Per cent. Nitrogenous Matters, dry basis, Mothers.

A. = 14.11 ± .073
S. D. = 1.147 ± .051
C. V. = 8.13 ± .365

Per cent. Nitrogenous Matters, dry basis, Daughters.

A. = 12.74 ± .171
S. D. = 2.698 ± .121
C. V. = 21.18 ± .992

Coef. Cor. —.387 ± .054

TABLE X.

CORRELATION IN PER CENT. NITROGENOUS MATTERS, DRY BASIS, BETWEEN MOTHERS SELECTED FOR LOW NITROGEN, AND DAUGHTERS CROP OF 1907.

Per cent. Daughters.	Per cent. Mothers. 7	8	9	
7			1	1
8	1		1	2
9	1		3	4
10	1	3	2	6
11	3	8	6	17
12	5	12	5	22
13	1	5	4	10
14	3	5	6	14
15		8	2	10
16	2	2	1	5
17	1	2		3
18		1		1
19				0
20	1	2		3
	19	48	31	98

Per cent. Nitrogenous Matters, dry basis, Mothers.	Per cent. Nitrogenous Matters, dry basis, Daughters.
A. = 8.122 ± .015	A. = 12.81 ± .170
S. D. = .222 ± .011	S. D. = 2.493 ± .120
C. V. = 2.733 ± .131	C. V. = 19.46 ± .972

Coef. Cor. −.510 ± .051

In the tables on the next page note the wide difference between the selected mother tubers. There are two classes vacant between the highest of the low nitrogen mother tubers and the lowest of the high nitrogen tubers, yet the progeny of each selection show frequency distributions so nearly the same that they might be interchanged. There is evidently no inheritance of these fluctuations.

TABLE XI.

'REQUENCY DISTRIBUTION OF NITROGENOUS MATTERS, FRESH BASIS, IN HIGH AND IN LOW NITROGEN PLOTS OF 1907, COMPARED WITH WEIGHTED MOTHERS.

CLASSES IN PER CENT.	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9	4.1	A.	S. D.	C. V.
Daughters High Nit.			1	14	17	14	25	14	12	10	4		1		1	2.51 ± .028	.437 ± .020	17.41 ± .800
Weighted Mothers High Nit.						78	35									2.23		
Weighted Mothers Low Nit.	10	56	32													1.55		
Daughters Low Nit.		1	3	4	10	18	27	16	6	8	3	2				2.51 ± .027	.392 ± .019	15.62 ± .771

TABLE XII.

'REQUENCY DISTRIBUTION OF NITROGENOUS MATTERS, DRY BASIS, IN HIGH AND IN LOW NITROGEN PLOTS OF 1907, COMPARED WITH WEIGHTED MOTHERS.

CLASSES IN PER CENT.	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	A.	S. D.	C. V.
Daughters High Nit.		2	9	14	14	19	21	7	10	5	5	3	1	2	0	1	12.74 ± .171	2.698 ± .121	21.18 ± .992
Weighted Mothers High Nit.						12	21	35	33	12							14.11 ± .073	1.147 ± .051	8.13 ± .365
Weighted Mothers Low Nit.	19	48	31														8.12 ± .015	.222 ± .011	2.73 ± .131
Daughters Low Nit.	1	2	4	6	17	22	10	14	10	5	3	1	0	1			12.81 ± .170	2.493 ± .120	19.46 ± .972

TABLE XIII.

CORRELATION IN PER CENT. DRY MATTER BETWEEN MOTHERS SELECTED FOR HIGH NITROGEN, AND DAUGHTERS CROP OF 1907.

Per cent. Daughters.	Per cent. Mothers. 15	16	17	18	19	
16	1		1	1		3
17		1	2	3		6
18		3		6	1	10
19	7	6	1	9	3	26
20	8	7	3	4	7	29
21	2	10	1	3		16
22	1	7	2	4		14
23	1	2	1	2	1	7
24	1					1
25			1			1
	21	36	12	32	12	113

Per cent. Dry Matter, Mothers.

A. = 16.81 ± .084
S. D. = 1.316 ± .059
C. V. = 7.829 ± .351

Per cent. Dry Matter, Daughters.

A. = 19.98 ± .111
S. D. = 1.745 ± .078
C. V. = 8.734 ± .395

Coef. Cor. = —.140 ± .062

TABLE XIV.

CORRELATION IN PER CENT. DRY MATTER BETWEEN MOTHERS SELECTED FOR LOW NITROGEN, AND DAUGHTERS CROP OF 1907.

Per cent. Daughters.	Per cent. Mothers. 16	17	18	19	20	22	
15					1		1
16			1	1	1	1	4
17			3	1	1		5
18			4	4	2	2	12
19	1		5	4	2	2	14
20	4	1	5	11	1	4	26
21	5	1	1	9	1		17
22	1	3		7			11
23	1	1		4			6
24				1			1
25							0
26		1					1
	12	7	19	42	9	9	98

Per cent. Dry Matter, Mothers.

A. = 18.66 ± .105
S. D. = 1.545 ± .074
C. V. = 8.28 ± 4.02

Per cent. Dry Matter, Daughters.

A. = 19.93 ± .131
S. D. = 1.923 ± .093
C. V. = 9.649 ± .469

Coef. Cor. —.286 ± .063

TABLE XV.

CORRELATION IN PER CENT. DRY MATTER BETWEEN MOTHERS, AND DAUGHTERS CROP OF 1907, CONSIDERING BOTH HIGH AND LOW NITROGEN PLOTS.

Per cent. Daughters. \ Per cent. Mothers.	15	16	17	18	19	20	21	22	
15						1			1
16	1		1	2	1	1		1	7
17		1	2	6	1	1			11
18		3		10	5	2		2	22
19	7	7	1	14	7	2		2	40
20	8	11	4	9	18	1		4	55
21	2	15	2	4	9	1			33
22	1	8	5	4	7				25
23	1	3	2	2	5				13
24	1				1				2
25			1						1
26			1						1
	21	48	19	51	54	9	0	9	211

Per cent. Dry Matter, Mothers.

A. = 17.67 ± .079
S. D. = 1.70 ± .056
C. V. = 9.62 ± .316

Per cent. Dry Matter, Daughters.

A. = 19.96 ± .085
S. D. = 1.83 ± .060
C. V. = 9.17 ± .301

Coef. Cor. —.194 ± .045

TABLE XVI.

CORRELATION IN PER CENT. DRY MATTER BETWEEN MOTHERS, AND DAUGHTERS CROP OF 1908, CONSIDERING BOTH HIGH AND LOW NITROGEN PLOTS.

Per cent. Daughters. \ Per cent. Mothers.	17	18	19	20	21	
8			1			1
9	1		1		1	3
10	2	1	1	1		5
11	4	3	3	1	1	12
12	4		4	5	2	15
13		1	8	8	1	18
14	1		4	4	1	10
15		1		1		2
16		1				1
	12	7	22	20	6	67

Per cent. Dry Matter, Mothers.

A. = 19.01 ± .100
S. D. = 1.21 ± .071
C. V. = 6.37 ± .371

Per cent. Dry Matter, Daughters.

A. = 12.19 ± .129
S. D. = 1.56 ± .091
C. V. = 12.79 ± .757

Coef. Cor. .228 ± .078

TABLE XVII.

FREQUENCY DISTRIBUTION OF NITROGENOUS MATTERS, FRESH BASIS, IN HIGH AND IN LOW NITROGEN PLOTS OF 1908, COMPARED WITH WEIGHTED MOTHERS.

CLASSES IN PER CENT.	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	A.	S. D.	C. V.
Daughters High Nit.	2	10	9	8	3	1			2.32 ± .028	.238 ± .020	10.26 ± .860
Weighted Mothers High Nit.						6	16	11	3.13		
Weighted Mothers Low Nit.		26	7						2.14		
Daughters Low Nit.	2	3	6	10	8	3	1		2.48 ± .033	.280 ± .023	11.24 ± .942

TABLE XVIII.

FREQUENCY DISTRIBUTION OF NITROGENOUS MATTERS, DRY BASIS, IN HIGH AND IN LOW NITROGEN PLOTS OF 1908, COMPARED WITH WEIGHTED MOTHERS.

CLASSES IN PER. CENT.	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25*	27†	33	A.	S. D.	C. V.
Daughters High Nit.							2	3	3	2	1	8	5		4		1	3	1	20.6 ± .459	3.91 ± 3.25	18.98 ± 1.63
Weighted Mothers H. Nit.							6	4	9	5	4	5								17.36		
Weighted Mothers L. Nit.	2	14	10	7																10.67		
Daughters Low Nit.				1		1	1	5	2	4	2	1	7	4	3	2				19.3 ± .358	3.05 ± .253	15.80 ± 1.35

* One class vacant and omitted.

† Five classes vacant and omitted.

TABLE XIX.

THE RELATION BETWEEN WEIGHT OF TUBER AND YIELD IN SELECTIONS FOR LOW NITROGEN.

Weight Seed tuber 1906.	Yield 1907 (grams).	Hills planted 1908.	Weight seed tuber 1908.	Yield 1908 (grams).
136	644			
158	1472	53-56 41-44	77 109	380 75
203	1560	49-52 45-48	88 88	220 30
129	1522			
187	1741	57-60	105	354
151	1797	65-68	114	543
106	1665	69-72	118	100
114	1776	61-64 73-76	168 69	1635 423
103	1530	77-80	92	964
120	1149			

TABLE XX.

HIGH NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 19		18.02	2.48	13.76	119
Daughter tuber	1	19.4	2.09	10.77	114
"	1	19.1	2.81	14.71	122
"	1	19.4	2.00	10.31	103
Daughter tuber	2	22.4	1.97	8.79	66
"	2	22.9	2.17	9.47	55
"	2	21.6	2.11	9.77	37
Daughter tuber	3	23.0	1.98	10.65	115
"	3	22.2	2.18	9.82	66
"	3	21.3	1.74	8.17	49
Daughter tuber	4	19.3	1.86	9.63	272
"	4	19.2	1.98	10.31	123
"	4	----	----	----	---

TABLE XX—*Continued.*

HIGH NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 33		16.40	2.34	14.27	165
Daughter tuber	5	21.3	2.49	11.69	94
"	5	21.8	2.52	11.56	74
"	5	21.5	1.99	9.25	59
Daughter tuber	6	17.6	2.20	12.50	90
"	6	19.8	2.52	12.72	59
"	6	19.8	2.53	12.77	49
Daughter tuber	7	20.5	2.43	11.85	70
"	7	20.0	1.97	9.85	53
"	7	21.7	2.14	9.86	41
Daughter tuber	8	21.6	2.77	12.82	49
"	8	22.8	2.92	12.80	43
"	8	21.5	2.20	10.23	30
Mother tuber, No. 35		14.75	2.36	16.00	145
Daughter tuber	9	19.4	2.17	11.18	60
"	9	21.0	2.64	12.57	60
"	9	23.8	2.94	12.35	29
Daughter tuber	10	19.3	2.11	10.93	219
"	10	19.0	2.49	13.10	138
"	10	23.0	2.69	11.70	68
Daughter tuber	11	19.1	2.16	11.31	150
"	11	19.8	2.30	11.61	95
"	11	15.8	2.66	16.83	58
Daughter tuber	12	18.8	1.95	10.37	149
"	12	19.2	2.32	12.08	109
"	12	20.1	2.24	11.14	81
Mother tuber, No. 49		17.98	2.37	13.18	118
Daughter tuber	13	18.4	3.69	20.05	37
"	13	18.8	4.11	21.86	21
"	13	21.3	2.52	11.83	17
Daughter tuber	14	Did not grow			
Daughter tuber	15	16.6	3.29	19.82	90
" [1]	15	17.9	3.00	16.76	59
"	15	16.4	2.27	13.84	41
Daughter tuber	16	17.9	2.26	12.62	116
"	16	22.1	3.19	14.43	39
"	16	19.9	1.97	9.90	33

1. Planted in hills 21, 22, 23, 24 (1908).

TABLE XX—*Continued.*

HIGH NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 55		16.40	2.49	15.12	137
Daughter tuber	17	17.1	2.64	15.44	114
"	17	20.5	2.42	11.80	85
"	17	18.6	2.44	13.12	69
Daughter tuber	18	19.2	2.17	11.30	83
"	18	19.9	2.61	13.11	75
"	18	19.5	3.09	15.84	43
Daughter tuber	19	21.5	2.42	11.25	185
" 2	19	17.6	2.91	16.53	114
"	19	21.6	2.11	9.77	59
Daughter tuber	20	21.2	2.44	11.51	75
"	20	20.9	2.70	12.92	67
"	20	21.6	2.03	9.39	43
Mother tuber, No. 57		16.13	2.42	15.00	146
Daughter tuber	21	21.5	1.94	9.02	111
"	21	22.8	2.27	9.95	82
"	21	18.7	2.91	15.56	48
Daughter tuber	22	20.1	2.33	11.59	97
"	22	19.4	2.23	11.49	76
"	22	21.5	2.46	11.44	59
Daughter tuber	23	18.9	2.45	12.96	190
"	23	21.2	1.96	9.24	116
"	23	22.5	1.97	8.75	69
Daughter tuber	24	20.6	2.29	11.11	85
"	24	18.5	2.51	13.56	80
"	24	22.1	1.99	9.00	45
Mother tuber, No. 107		16.83	2.38	14.14	138
Daughter tuber	25	22.5	2.45	10.89	120
"	25	24.7	1.92	7.77	93
"	25	22.8	2.06	9.03	63
Daughter tuber	26	16.0	2.53	15.81	113
"	26	21.8	2.71	12.43	79
"	26	20.2	2.79	13.81	55
Daughter tuber	27	19.8	2.48	12.52	104
"	27	17.4	2.28	13.10	62
"	27	21.0	2.19	10.43	52
Daughter tuber	28	19.4	2.35	12.11	110
"	28	17.5	3.21	18.34	49
"	28	20.5	2.70	13.17	38

2. Planted in hills 33, 34, 35, 36 (1908).

TABLE XX—*Concluded.*

HIGH NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 138		18.81	2.36	12.50	106
Daughter tuber, 1	29	20.5	3.10	15.12	68
"	29	20.3	3.11	15.32	60
"	29	22.7	3.04	13.39	60
Daughter tuber	30	19.8	2.81	14.19	63
"	30	18.7	2.51	13.42	62
"	30	20.5	2.62	12.78	61
Daughter tuber, 2	31	18.7	2.87	15.35	94
"	31	19.9	2.93	14.72	67
"	31	20.2	3.02	14.95	54
Daughter tuber	32	19.4	2.46	12.68	75
"	32	18.3	2.56	13.99	70
"	32	20.1	2.82	14.03	56
Mother tuber, No. 144		15.35	2.36	15 37	110
Daughter tuber	33	20.0	2.40	12.00	90
"	33	----	----	----	----
"	33	----	----	----	----
Daughter tuber	34	20.2	2.44	12.08	99
"	34	21.2	2.56	12.07	98
"	34	----	----	----	----
Daughter tuber	35	20.1	2.39	11.89	120
"	35	20.4	2.18	10.68	88
"	35	22.1	2.52	11.40	69
Daughter tuber	36	19.7	2.07	10.50	118
" 3	36	19.3	3.19	16.53	79
"	36	19.9	2.56	12.86	76
Mother tuber, No. 155		17.74	2.28	12.85	113
Daughter tuber, 4	37	18.8	3.30	17.55	74
"	37	18.1	3.00	16.57	69
" 5	37	21.1	3.17	15.02	67
Daughter tuber	38	18.6	2.76	14.84	114
"	38	20.1	2.65	13.18	76
"	38	17.9	2.62	14.64	54
Daughter tuber, 6	39	17.2	3.14	18.25	99
"	39	19.4	2.31	11.90	91
" 7	39	18.2	2.97	16.32	72
Daughter tuber, 8	40	16.9	3.29	19.47	89
"	40	19.7	2.56	12.99	78
"	40	20.2	3.19	15.79	58

1. Planted in hills 1, 2, 3, 4 (1908).
2. Planted in hills 29, 30, 31, 32 (1908).
3. Planted in hills 13, 14, 15, 16 (1908).
5. Planted in hills 9, 10, 11, 12 (1908).
6. Planted in hills 5, 6, 7, 8 (1908).
7. Planted in hills 37, 38, 39, 40 (1908).
[illegible]

TABLE XXI.

LOW NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 4		17.32	1.53	8.83	136
Daughter tuber	41	21.88	2.30	10.51	60
"	41	----	----	----	----
"	41	----	----	----	----
Daughter tuber	42	25.81	2.20	8.52	70
"	42	21.06	2.68	12.73	55
"	42	22.52	1.79	7.95	53
Daughter tuber	43	22.41	2.42	10.80	44
"	43	21.63	3.10	14.33	39
"	43	----	----	----	----
Daughter tuber	44	19.56	2.68	13.70	111
"	44	----	----	----	----
"	44	----	----	----	----
Mother tuber, No. 10		18.11	1.45	8.01	158
Daughter tuber, 1	45	19.57	2.03	10.37	77
"	45	19.01	2.24	11.78	83
"	45	20.35	2.60	12.78	67
Daughter tuber	46	19.60	2.88	14.70	61
"	46	----	----	----	----
"	46	----	----	----	----
Daughter tuber, 2	47	19.08	1.87	9.80	109
"	47	20.08	2.45	12.20	109
"	47	16.51	2.43	14.72	118
Daughter tuber	48	Did not grow			
Mother tuber, No. 13		16.01	1.42	8.87	203
Daughter tuber	49	20.06	2.10	10.47	65
"	49	21.08	2.27	10.77	55
"	49	19.12	2.78	14.54	70
Daughter tuber	50	21.02	2.46	11.70	103
"	50	20.04	2.28	11.38	74
" 3	50	21.43	2.02	9.43	88
Daughter tuber	51	23.06	1.69	7.33	56
"	51	20.69	3.08	14.89	88
"	51	20.23	2.36	11.67	116
Daughter tuber	52	21.52	2.41	11.20	78
"	52	20.05	2.48	12.37	100
" 4	52	20.62	1.97	9.55	88

1. Planted in hills 53, 54, 55, 56 (1908).
2. Planted in hills 41, 42, 43, 44 (1908).
3. Planted in hills 49, 50, 51, 52 (1908).
4. Planted in hills 45, 46, 47, 48 (1908).

TABLE XXI—*Continued.*

LOW NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 52		18.72	1.30	6.95	129
Daughter tuber	53	20.01	2.30	11.50	78
"	53	19.98	2.73	13.66	120
"	53	----	----	----	----
Daughter tuber	54	17.74	2.57	14.49	312
"	54	18.94	1.87	9.87	206
"	54	----	----	----	----
Daughter tuber	55	20.86	2.36	11.31	76
"	55	21.24	2.37	11.16	50
"	55	15.94	2.57	16.12	68
Daughter tuber	56	19.87	2.37	11.92	93
"	56	20.85	1.79	8.58	48
"	56	18.18	2.43	13.36	45
Mother tuber, No. 101		18.30	1.63	8.91	187
Daughter tuber	57	16.75	2.15	12.83	215
"	57	18.79	2.66	14.15	96
"	57	20.53	1.94	9.45	66
Daughter tuber	58	18.33	2.22	12.11	147
"	58	17.34	2.46	14.18	117
" 5	58	18.28	2.06	11.27	105
Daughter tuber	59	17.97	2.28	12.68	105
"	59	17.94	2.48	13.82	99
"	59	15.80	2.53	16.01	88
Daughter tuber	60	18.91	2.54	13.43	97
"	60	19.71	2.41	12.22	92
"	60	18.56	2.60	14.01	83
Mother tuber, No. 132		19.09	1.52	7.96	151
Daughter tuber, 1	61	19.81	2.14	10.80	114
"	61	19.81	2.39	12.06	127
"	61	20.18	2.31	11.44	100
Daughter tuber	62	19.91	2.47	12.40	111
"	62	20.10	2.38	11.84	73
"	62	20.73	3.44	16.60	65
Daughter tuber	63	21.71	2.60	11.97	93
"	63	22.52	2.45	10.88	84
"	63	23.86	2.94	12.32	85
Daughter tuber	64	20.79	2.91	14.00	129
"	64	18.90	3.04	16.08	74
"	64	----	----	----	----

5. Planted in hills 57, 58, 59, 60 (1908).
1. Planted in hills 65, 66, 67, 68 (1908).

TABLE XXI—*Continued.*

LOW NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 146		18.90	1.50	7.94	106
Daughter tuber	65	22.79	2.54	11.14	158
"	65	23.21	2.73	11.76	104
"	65	23.23	2.62	11.28	104
Daughter tuber	66	21.36	2.53	11.84	88
"	66	22.18	2.67	12.04	70
"	66	22.31	2.54	11.38	69
Daughter tuber	67	17.43	2.35	13.48	96
"	67	20.26	2.56	12.63	60
"	67	----	----	----	----
Daughter tuber, 2	68	18.55	2.14	11.53	118
"	68	21.43	2.66	12.41	68
"	68	----	----	----	----
Mother tuber, No, 148		19.85	1.61	8.11	114
Daughter tuber, 3	69	19.80	2.08	10.50	168
" 4	69	19.28	2.18	11.30	92
"	69	14.97	2.63	17.57	69
Daughter tuber	70	Did not grow			
Daughter tuber	71	21.28	3.26	15.32	95
"	71	15.60	3.15	20.19	72
"	71	19.19	2.66	13.86	60
Daughter tuber	72	18.08	2.49	13.77	173
"	72	16.84	2.51	14.90	124
"	72	18.46	2.80	15.17	83
Mother tuber, No. 153		19.26	1.61	8.36	103
Daughter tuber	73	21.53	2.71	12.58	99
"	73	18.81	3.15	16.74	91
"	73	20.57	2.33	11.33	73
Daughter tuber	74	20.01	2.90	14.49	88
"	74	21.63	2.78	12.85	78
"	74	19.57	2.85	14.56	85
Daughter tuber	75	21.86	3.20	14.64	46
"	75	21.21	3.29	15.51	44
"	75	----	----	----	----
Daughter tuber	76	17.85	2.76	15.46	87
"	76	17.58	3.53	20.08	87
"	76	22.46	3.04	13.53	58

2. Planted in hills 69, 70, 71, 72 (1908).
3. Planted in hills 61, 62, 63, 64 (1908).
4. Planted in hills 73, 74, 75, 76 (1908).

TABLE XXI—*Concluded.*

LOW NITROGEN EXTREMES OF 1906 AND THEIR PROGENY OF 1907.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight, grams.
Mother tuber, No. 157		21.66	1.43	6.60	120
Daughter tuber	77	Did not grow			
Daughter tuber	78	19.65	2.44	12.41	157
" 5	78	18.79	2.21	11.76	92
"	78	18.84	2.95	15.66	91
Daughter tuber	79	19.95	2.74	13.73	141
"	79	19.89	1.59	7.99	63
"	79	19.63	2.43	12.38	58
Daughter tuber	80	17.83	3.09	17.33	75
"	80	18.28	2.26	12.36	75
"	80	16.28	3.33	20.45	57

5. Planted in hills 77, 78, 79, 80 (1908).

TABLE XXII.

HIGH EXTREMES FROM THE HIGH NITROGEN PLOT OF 1907 AND THEIR PROGENY OF 1908.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight.
Mother tuber (from tuber No. 49 in 1906)........	15*a*	16.60	3.29	19.82	90
Daughter tuber.........	22	11.99	2.44	20.35	90
"	22	12.04	1.88	15.61	58
"	23	10.77	2.16	20.05	102
"	24	10.69	2.28	21.33	86
"	24	8.96	2.06	22.99	84
Mother tuber (from tuber No. 55 in 1906)........	19*b*	17.60	2.91	16.53	114
Daughter tubers all too small to analyze.					
Mother tuber (from tuber No. 138 in 1906).......	29*a*	20.50	3.10	15.12	68
Daughter tubers all too small to analyze.					
Mother tuber (from tuber No. 138 in 1906).......	31*a*	18.70	2.87	15.35	94
Daughter tuber.........	29	9.24	2.51	27.16	62
"	32	12.63	2.66	21.06	50
Mother tuber (from tuber No. 144 in 1906).......	36*b*	19.30	3.19	16.53	79
Daughter tuber.........	13	9.94	2.28	22.93	126
"	13	11.01	2.14	19.43	74
"	14	13.60	2.05	15.07	92
"	14	11.49	2.41	20.97	78
"	14	12.74	2.29	17.97	61
"	15	14.24	2.11	14.81	102
"	15	12.02	2.45	20.38	72
"	16	12.64	2.11	16.69	84
"	16	14.03	2.21	15.75	50
Mother tuber (from tuber No. 155 in 1906).......	37*a*	18.80	3.30	17.55	74
Daughter tuber.........	25	10.57	2.26	21.38	125
"	27	8.47	2.79	32.94	61
Mother tuber (from tuber No. 155 in 1906).......	37*c*	21.10	3.17	15.02	67
Daughter tuber.........	9	12.07	2.18	18.06	71
"	10	11.10	2.50	22.52	60
"	11	9.37	2.56	27.32	56
"	12	11.88	2.05	17.25	52

TABLE XXII—*Concluded.*

HIGH EXTREMES FROM THE HIGH NITROGEN PLOT OF 1907 AND THEIR PROGENY OF 1908.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight.
Mother tuber (from tuber No. 155 in 1906)	39*a*	17.20	3.14	18.25	99
Daughter tuber	5	10.19	2.35	23.06	72
"	6	10.29	2.79	27.11	85
"	8	10.88	1.87	17.18	80
Mother tuber (from tuber No. 155 in 1906)	39*c*	18.20	2.97	16.32	72
Daughter tuber	37	10.67	2.12	19.86	66
"	38	10.48	2.11	20.13	62
"	39	11.05	2.30	20.81	60
"	40	13.12	2.58	19.66	50
Mother tuber (from tuber No. 155 in 1906)	40*a*	16.90	3.29	19.47	89
Daughter tuber	17	11.98	2.44	20.36	69
"	17	13.88	2.27	16.35	50
"	20	11.24	2.29	20.37	82
"	20	11.59	2.88		

TABLE XXIII.

LOW EXTREMES FROM THE LOW NITROGEN PLOT OF 1907 AND THEIR PROGENY OF 1908.

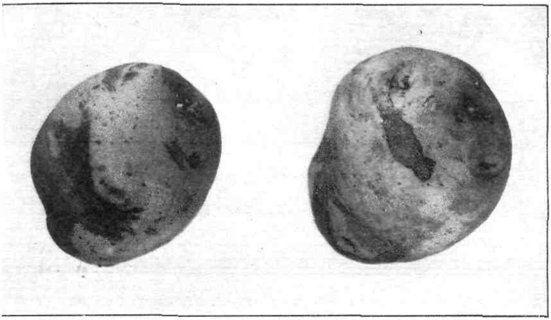
	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight.
Mother tuber (from tuber No. 10 in 1906)	45*a*	19.57	2.03	10.37	77
Daughter tuber	53	10.39	2.38	22.91	70
"	56	12.51	2.81	22.46	88
Mother tuber (from tuber No. 10 in 1906)	47*a*	19.08	1.87	9.80	109
Daughter tubers all too small to analyze.					
Mother tuber (from tuber No. 13 in 1906)	50*c*	21.43	2.02	9.43	88
Daughter tuber	51	13.61	2.36	17.34	64
"	52	12.87	3.13	24.32	120
Mother tuber (from tuber No. 13 in 1906)	52*c*	20.62	1.97	9.55	88
Daughter tubers all too small to analyze.					
Mother tuber (from tuber No. 101 in 1906)	58*c*	18.28	2.06	11.27	105
Daughter tuber	57	14.97	2.43	16.23	121
"	58	16.36	2.70	16.50	56
"	60	11.48	2.74	23.87	116
Mother tuber (from tuber 132 in 1906)	61*a*	19.81	2.14	10.80	114
Daughter tuber	65	12.68	2.61	20.58	69
"	66	10.80	2.41	22.31	153
"	67	12.76	2.66	20.85	113
"	67	13.06	2.77	21.21	71
"	68	11.60	2.58	22.24	85
"	68	11.58	2.57	22.19	57
Mother tuber (from tuber No. 146 in 1906)	68*a*	18.55	2.14	11.53	118
Daughter tubers all too small to analyze.					

TABLE XXIII—*Concluded.*

LOW EXTREMES FROM THE LOW NITROGEN PLOT OF 1907 AND THEIR PROGENY OF 1908.

	From Hill No.	Dry Matter.	Nit. Mat. fresh basis.	Nit. Mat. dry basis.	Weight.
Mother tuber (from tuber No. 148 in 1906)	69*a*	19.80	2.08	10.50	168
Daughter tuber	61	13.85	2.49	17.97	77
"	61	13.39	2.33	17.40	59
"	61	12.47	2.92	23.41	60
"	62	13.10	2.70	20.61	101
"	62	14.18	2.95	20.80	81
"	62	12.77	2.32	18.17	66
"	63	12.12	2.43	20.05	167
"	63	11.85	2.69	22.70	126
"	63	13.21	2.01	15.21	69
"	64	14.11	2.03	14.38	71
"	64	13.76	2.41	17.51	76
"	64	15.10	1.82	12.05	69
Mother tuber (from tuber No. 148 in 1906)	69*b*	19.28	2.18	11.30	92
Daughter tuber	74	13.18	2.37	17.98	54
Mother tuber (from tuber No. 157 in 1906)	78*b*	18.79	2.21	11.76	92
Daughter tuber	77	13.04	2.49	19.10	70
"	77	13.13	2.47	18.81	60
"	79	13.15	2.08	15.81	63
"	79	11.93	2.55	21.37	102
"	79	12.32	1.93	15.66	84
"	80	12.61	2.62	20.78	89
"	80	12.42	----	----	109
"	80	13.78	2.25	16.32	103

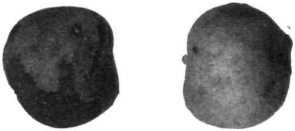
PLATE I.



a. Rector of Woodstock. The only instance known where bud variation has produced color. It is unknown whether mother variety possessed purple sprouts.

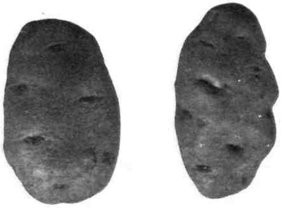
b. La Bretonne. The white-skinned variation at the right was constant.

BUD VARIATION IN COLOR.



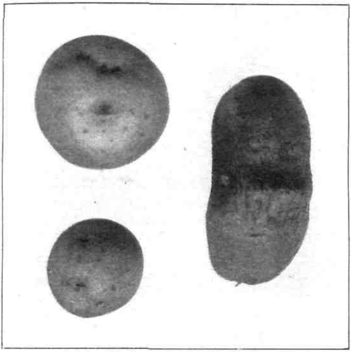
a. Early Sunrise. White variation at the right was constant.

b. Bole Zoegling. White variation at the right was constant. The apparent color in the reproduction is due to the corky layer having been rubbed off in places.

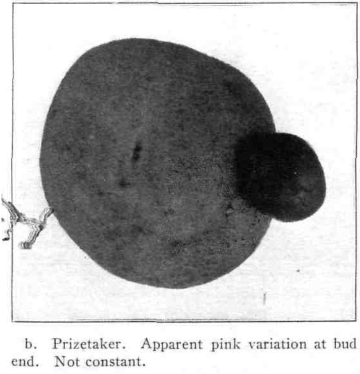


c. Early Ohio. Deep-eyed variation at the right was constant.

BUD VARIATION IN COLOR AND DEPTH OF EYE.



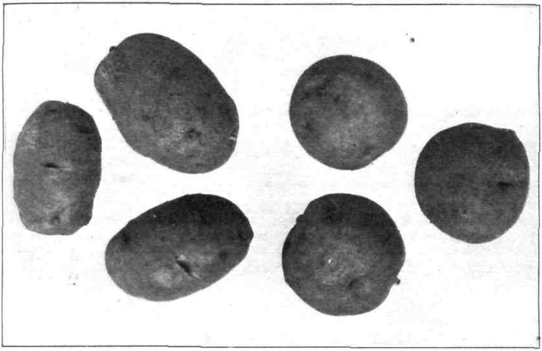
a. Aradaras. Apparent pink variation at right. Not constant.



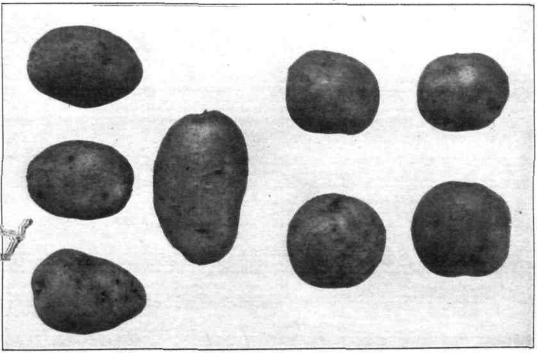
b. Prizetaker. Apparent pink variation at bud end. Not constant.

c. Peculiar variation i habit of tuber formatioı Constant.

ODD BUD VARIATIONS.

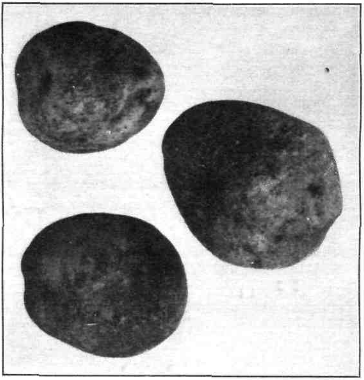


a. Early Ohio. Round variation at the right was constant.

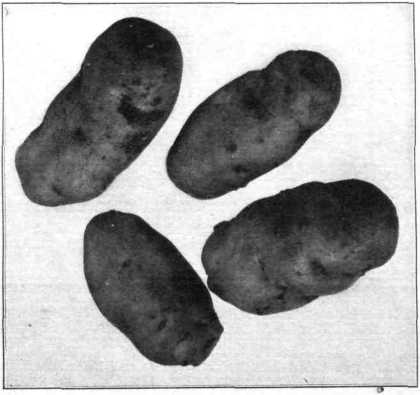


b. Silver Hill. Round variation at the right was constant.

BUD VARIATIONS IN SHAPE.



a. Normal State of Maine.



b. An elongated variation of above. It was evidently due to some attending condition during growth, for it did not reproduce itself.

BUD VARIATIONS NOT INHERITED.

NEW HAVEN, December 1, 1909.

To His Excellency, Frank B. Weeks, Governor of Connecticut:

As required by law, this station respectfully submits to you the Fourteenth Report on Food Products for the year ending July 31, 1909, by John Phillips Street.

Respectfully yours,

E. H. JENKINS, *Director.*

PART II.

FOURTEENTH REPORT ON FOOD PRODUCTS AND SECOND REPORT ON DRUG PRODUCTS, 1909.

(Examined during the year ending July 31, 1909.)

BY JOHN PHILLIPS STREET.*

This station is required by law to make examinations of food products and drugs and to report to the dairy commissioner all cases of adulteration which are discovered. Under this law the sampling agent of the station has visited a considerable number of places and has bought a large number of samples which have been examined and all cases of adulteration reported to the dairy commissioner. An account of this work is given in the following pages.

The dairy commissioner and his deputy have sent a large number of samples of vinegar and butter, the sale of which is regulated by special statutes, as well as samples of other foods and drugs, which he is authorized to take under the food law. These are but briefly noticed here, being discussed in the commissioner's report, where account is also given of the results of prosecution under the law.

Lastly, a considerable number of samples of food and drug products have been examined for individuals, which will likewise receive brief mention.

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* The analytical work herein described was done jointly with Messrs. Bailey, Morrison, Brautlecht, Rodman and Roe.

I. FOOD PRODUCTS.

BREAKFAST FOODS.

Forty-eight kinds or brands of cereal breakfast foods have been found on sale in the State and examined here.

Their names and manufacturers are given in Table I and their analyses, weights of packages and prices in Table II.

The results of this work are briefly summarized as follows: In general they show evidence of care and cleanliness in their preparation and are enclosed in attractive cartons which protect them from contamination. In no case has any adulterant or inferior admixture been found and the foods were apparently made from the grains named on the label. The foods are chiefly made from corn, oats, rice, wheat or barley. The whole grain, or a portion of it, freed from most of the chaff, is crushed or ground. In some cases it is cooked more or less, or by suitable ferments a part of the starch is made more soluble, "predigested." Many of the ready cooked cereals have a little added salt.

The weights of the contents of the packages in all but four cases equaled or exceeded the weights stated on the labels. The largest deficiency amounted to more than six per cent. This shortage cannot be explained by the drying of the goods after packing, and if at all common or constant, is too large.

The cost per pound varies greatly. In general, the prices of corn and oat products are lowest, rice next, while wheat and barley cost considerably more than the others. In general, cost bears a much closer relation to the attractiveness of the package than to the probable nutritive value of the contents. But the care taken in the selection of the grain and in its manufacture are of course elements of cost which cannot be determined solely by laboratory tests nor by the purchaser.

In general, ready cooked or "predigested" cereals cost two or three times as much per pound as those not thus treated.

Regarding chemical composition, the oat foods contain much more protein (nitrogenous matter) and fat and have a higher energy value than the other cereal preparations, wheat ranks next as regards protein and fat, followed by barley and corn, but the three are not very unlike in energy value.

Silly reports of the presence of drugs or poisons in certain brands of breakfast food have been investigated repeatedly by others and proved to be false.

It remains to notice the statements on the labels of these foods, which to comply with the national and state laws must be truthful and not misleading.

The following do not, in our opinion, fully comply with the law, or are at least objectionable:

20998. *E-C Corn Flakes Toasted.* "The thorough cooking converts the starch into digestible substances."

Unconverted starch is a perfectly digestible substance and a healthy person can digest it himself quite as safely and conveniently as a factory. This article contains a high percentage of water-soluble carbohydrates, but also 61.31 per cent. of unconverted starch. Only a small portion of the starch has therefore been converted.

21000. *Cook's Flaked Rice.* "Expert's analysis shows that Flaked Rice contains 87 per cent. nutriment, beef 45 per cent., potatoes 21 per cent." "One pound Flaked Rice contains 21 per cent. more life-giving nourishment than a pound of beef and a pound of potatoes combined."

The sample analyzed contained 86.83 per cent. of nutritive matter, substantiating the first clause of the claim. As to composition it should be noted, however, that the nutriment in this food, as in potatoes, consists chiefly of carbohydrates, nearly all of it insoluble starch, while in beef, protein constitutes most of the nourishment. The comparison of foods as to value, without considering the nature of the nourishment in them, is almost as futile as a comparison of punctuality and temperature.

21381. *Milk Rice.* "Nature provided Rice exclusively for human use. It contains in a larger degree the properties of pure, fresh milk than any other grain. Before rice is dried or ripened in the fields the center of each grain is milk."

The term "milk" is sometimes applied to the white juice of certain plants, but never with the idea that there is any resemblance to milk, the food, save in color and consistence. Two of the characteristics of milk are its high fat and its low ash content; the reverse is true of Milk Rice. No grains possess in any marked degree the properties of milk. The statements of the manufacturer are clearly false and misleading.

21020. *Quaker Puffed Rice.* "The wonderful invention of puffing rice, cooks the starch granules so thoroughly that Quaker Puffed Rice is very largely a predigested food."

In spite of a large amount of soluble carbohydrates, it still contains 61.76 per cent. of insoluble starch. It is misleading to claim for a partially dextrinized food that it is predigested," because no digestive process has been employed and the changes brought about in the food have little relation to those caused by digestive ferments.

21184. *Holland Rusk.* The words "Made in Holland" appear on the label in large letters under a picture of a typical Dutch windmill; in small and inconspicuous type "Holland, Mich." is designated as the place of manufacture. The label is misleading, and the food is clearly misbranded.

21181. *Force.* "The Natural Food for Creating Power, Repairing Waste, Maintaining Energy." "Force is food, not medicine—food for tired nerves, overworked brains, flabby muscles, weak digestions. . . . A simple preparation of the Whole of the Wheat and Barley Malt, prepared by a process of careful malting and heating Peculiar to Itself. All the nourishing effects of wheat are in it with the tonic effect of malt."

Force contains less water-soluble carbohydrates than most foods of its class. Any real food is for tired nerves, overworked brains, etc. There is nothing in the description of its preparation or its chemical composition to indicate any very peculiar adaptation to the wants of the system.

21034. *Grape-Nuts.* "A Food for Brain and Nerve Centres." "Made by compounding and scientifically baking Wheat, Barley and a small amount of salt and yeast. There are no other ingredients whatsoever in Grape-Nuts." "In the processes the starch of the grains is largely transformed into grape-sugar." "The human system will absorb a greater amount of nourishment from Grape-Nuts than from a like amount of any other known food."

While our analysis shows the presence of a large amount of soluble carbohydrates, 36.34 per cent. of insoluble starch still remains. Exception may well be taken to the claim that Grape-Nuts is distinctly a brain or nerve food. Any real food is also brain food. The claims as to its nutritive power are likewise exaggerated.

21301. *Hornby's Steam Cooked Oat Meal.* "Steam cooking the kernels for several hours, thereby converting the starch into dextrine, then again drying by superheated air, which imparts a delicious flavor while preparing them for ready assimilation. . . . After drying in fire kilns for several hours, the hulls and impurities are removed." "Carbohydrates, 65.05, protein, 17.63, fat 7.38, phosphates, 3.53, water, 6.41."

Our analysis agrees with the claimed composition only in respect to carbohydrates. The figure given for phosphates, even if meant for total mineral matter, is twice as large as shown by analysis. The starch in this food is only slightly converted into dextrin, as it contains 59.23 per cent. of insoluble starch and only 3.69 per cent. of soluble carbohydrates. The statements on the package are not correct.

21686. *Saxon Wheat Food.* "A brain, nerve and muscle food."

Exception must be taken to such a claim for reasons before stated.

20963. *Cream of Wheat.* "Is not only one of the most delicate and delicious breakfast foods ever offered to the public, but in addition containing a very large percentage of gluten, is one of the most healthful and nutritious foods known."

The statement as to gluten is vague and somewhat misleading, as the table shows that it contains no more protein than the average food of its class. Moreover, most of these other wheat preparations contain quite as much nutriment as this.

21377. *Wheatlet.* "Exceptionally rich in the nitrogenous and phosphatic food elements necessary as a sustaining power for mental and physical labor."

Compared with the analyses of the other wheat preparations, it is seen that Wheatlet is not "exceptionally rich" in either of the elements specified.

21095. *Malt Breakfast Food.* "The Choicest Whole Wheat Scientifically Combined with the Best Barley Malt. Rich in Malt, Gluten and Phosphates." "Proteids, 11.63, Carbohydrates, 77.00, Fats, 1.75, Lignin and Cellulose, 0.73, Ash, 1.05, Water, 7.84."

The claimed analysis agrees satisfactorily with our results. It contains slightly more protein than any of the other wheat preparations examined, and is moderately high in ash. It is

no richer in phosphates, however, than many of the other breakfast foods. The malting process is very incomplete, for only about 13 per cent. of the protein and 20 per cent. of the starch have been rendered soluble.

20972. *Wheatena.* "The first of all breakfast foods, the best of all breakfast foods."

The enthusiasm of the manufacturer of this food is scarcely justified by the analysis.

21166. *Christian's Laxative Cereal Flakes.* Its claim, as "laxative," is probably based upon the fact that foods made from whole wheat are more laxative than those prepared from the more starchy portions. The examination reveals nothing which could give it more of this effect than other whole wheat meals.

TABLE I. LIST OF BREAKFAST FOODS EXAMINED WITH NAMES OF MANUFACTURERS.

Cerealine. American Hominy Co., Indianapolis.
Christian's Laxative Cereal Flakes. Christian's Natural Food Co., New York.
Cook's Flaked Rice. The American Rice Food & Mf'g. Co., Matawan, N. J.
Cook's Malto Rice. The American Rice Food & Mf'g. Co., Matawan, N. J.
Cream of Wheat. Cream of Wheat Co., Minneapolis.
E-C Corn Flakes Toasted. Egg-O-See Cereal Co., Chicago.
Force. The Force Food Co., Chicago.
F S Granulated Hominy. Quaker Oats Co., Chicago.
Grandmother's Crushed Oats. The Great Atlantic & Pacific Tea Co., New York.
Grandmother's A. & P. Selected Farina. The Great Atlantic & Pacific Tea Co., New York.
Grape Nuts. Postum Cereal Co., Battle Creek, Mich.
Health Brand White Oats. Lewis DeGroff & Son, New York.
Hecker's Farina. Hecker-Jones-Jewell Milling Co., New York.
Holland Rusk. B. Arendshorst & Sons, Holland, Mich.
H. O. New Process Hominy. The H. O. Co., Buffalo.
Hornby's Steam Cooked Oat Meal. The H. O. Co., Buffalo.
Kellogg's Toasted Corn Flakes. Toasted Corn Flake Co., Battle Creek, Mich.
Korn Kinks. The H. O. Co., Buffalo.
Malt Breakfast Food. The Malted Cereals Co., Burlington, Vt.
Mapl-Flake. Hygienic Food Co., Battle Creek, Mich.
Milk Rice. Milkrice Co., Chicago.
Mother's Crushed Oats. The Great Western Cereal Co., Chicago.
Nichols Snow White Samp. Austin, Nichols & Co., New York.

Paw-Nee Rolled Oats. The Pawnee Cereal Co., Cedar Rapids, Iowa.
Pettijohn's Breakfast Food. The American Cereal Co., Chicago.
Pillsbury's Best Cereal. Pillsbury-Washburn Flour Mills, Minneapolis.
Premier Farina. Francis H. Leggett Co., New York.
Premier 15 Minute Oat Flakes. Francis H. Leggett Co., New York.
Post Toasties. Postum Cereal Co., Battle Creek, Mich.
Pure Quaker Oats. The Quaker Oats Co., Chicago.
Quaker Best Yellow Corn Meal. The Quaker Oats Co., Chicago.
Quaker Cracked Wheat. The American Cereal Co., Chicago.
Quaker Puffed Rice. The Quaker Oats Co., Chicago.
Quaker Toasted Corn Flakes. The Quaker Oats Co., Chicago.
Quaker Wheat Berries. The Quaker Oats Co., Chicago.
Ralston Health Food. Ralston Purina Co., St. Louis.
Ralston Hominy Grits. Ralston Purina Co., St. Louis.
Saxon Wheat Food. The American Cereal Co., Chicago.
Scotch Brand Pearled Barley. The Quaker Oats Co., Chicago.
Shredded Whole Wheat. The Shredded Wheat Co., Niagara Falls.
Sovereign 15 Minute Oat Flakes. The Union Pacific Tea Co., New York.
Street Brand Perfection Farina.
Street Brand Perfection Hominy.
Triscuit. The Natural Food Co., Niagara Falls.
Wheatena. The Wheatena Co., New York.
Wheatlet. The Franklin Mills Co., Lockport, N. Y.
White Rose Brand Rolled Oats. Seeman Bros., New York.
Zest. The American Cereal Co., Chicago.

Standards of Composition.

The only standards yet adopted by this station, which can be applied to these foods, are those for corn meal and oatmeal.

"*Corn meal* is meal made from sound maize grain, and contains not more than fourteen (14) per cent. of moisture, not less than one and twelve-hundredths (1.12) per cent. of nitrogen, and not more than one and six-tenths (1.6) per cent. of ash."

"*Oatmeal* is meal made from hulled oats, and contains not more than twelve (12) per cent. of moisture, not more than one and five-tenths (1.5) per cent. of crude fiber, not less than two and twenty-four hundredths (2.24) per cent. of nitrogen, and not more than two and two-tenths (2.2) per cent. of ash."

The analyses show that all the foods of these two classes satisfy the standards in all particulars.

Methods of Analysis.

The methods used were those generally employed for the analysis of cattle foods, with the following additions:

TABLE II.—BREAKFAST FOODS.

Station No.	Brand.	Net weight ounces.	Price in cents. Per package.	Per pound.	Water.	Ether Extract.
	TO BE COOKED BEFORE USING.					
	Barley Preparation.					
21127	Scotch Pearled Barley	17.8	10	9.0	12.12	0.89
	Corn Preparations.					
21258	Nichols' Snow White Samp	30.9	10	5.2	13.39	0.32
21298	H. O. New Process Hominy	29.9	10	5.3	11.34	0.32
21370	F. S. Granulated Hominy	74.1	25	5.4	13.25	0.96
21328	Quaker Yellow Corn Meal	46.4	12	4.1	12.30	0.80
21262	Ralston Hominy Grits	29.9	10	5.3	11.28	2.89
21281	Street Perfection Hominy	31.0	6	3.1	12.43	1.29
	Oat Preparations.					
21400	Health Brand White Oats	32.9	12	5.8	10.92	7.81
21125	Grandmother's Crushed Oats	28.1	10	5.7	10.65	6.48
21300	Mother's Crushed Oats	24.3	10	6.6	10.85	6.08
21301	Hornby's Steam Cooked Oat Meal	28.8	15	8.3	10.58	6.67
21240	Premier Fifteen Minute Oat Flakes	24.2	10	6.6	11.34	5.36
21189	Paw-Nee Rolled Oats	25.1	10	6.4	10.75	6.65
21224	Pure Quaker Oats	24.2	10	6.6	10.83	5.95
20942	White Rose Rolled Oats	30.4	12	6.3	10.34	7.96
21165	Sovereign Fifteen Min. Oat Flakes	34.3	15	7.0	10.75	5.82
	Wheat Preparations.					
21369	Quaker Cracked Wheat	29.9	15	8.0	11.72	2.32
21686	Saxon Wheat Food	25.4	15	9.4	9.75	1.68
20963	Cream of Wheat	28.7	15	8.4	13.12	0.89
21377	Wheatlet	28.7	15	8.4	12.20	1.56
21018	Grandmother's A. & P. Farina	16.2	6	5.9	12.92	0.61
21019	*Hecker's Farina*	*15.8*	*10*	*10.1*	*12.73*	*0.74*
21009	Premier Farina	15.6	10	10.3	14.06	0.89
21095	Malt Breakfast Food	30.0	15	8.0	9.56	1.45
20996	Pillsbury's Best Cereal	31.8	15	7.6	11.34	0.74
21190	Ralston Health Food	29.2	15	8.2	12.36	1.72
20997	Street Perfection Farina	16.0	10	10.0	13.07	1.06
20972	Wheatena	25.2	15	9.5	10.44	2.78
21001	Pettijohn's Breakfast Food	23.0	11	7.6	10.26	1.97
21166	Christian's Laxative Cereal Flakes	21.3	25	18.8	13.04	1.37
	READY TO SERVE.					
	Corn Preparations.					
21299	Cerealine	10.4	9	13.8	11.17	0.42
20998	E-C Corn Flakes, Toasted	10.3	10	15.5	12.12	0.34
21128	Korn Kinks	8.1	5	9.9	11.98	0.42
20999	Post Toasties	10.8	10	14.8	11.67	0.26
21183	Quaker Toasted Corn Flakes	10.7	8	12.0	11.60	0.38
21028	Kellogg's Toasted Corn Flakes	9.7	10	16.5	11.67	0.23

PRICES, WEIGHTS AND ANALYSES.

Station No.	Crude Fiber.	Protein (N x 6.25).	Ash.	Nitrogen-Free Extract.	Starch.	Chlorin as Sodium Chlorid.	Water Extract.			
							Total.	Protein.	Ash.	Carbohydrates.
21127	0.26	9.50	0.96	76.27	69.24	....	6.73	1.81	0.78	4.14
21258	0.47	7.75	0.28	77.79	78.24	....	2.55	0.31	0.13	2.11
21298	0.17	8.00	0.35	79.82	74.42	....	2.89	0.31	0.18	2.40
21370	0.17	8.00	0.42	77.20	75.66	....	3.04	0.69	0.34	2.01
21328	0.16	7.50	0.53	78.71	75.71	....	2.24	0.75	0.34	1.15
21262	0.44	9.00	0.96	75.43	70.93	....	5.31	1.19	0.76	3.36
21281	0.14	7.87	0.40	77.87	74.52	....	3.38	0.50	0.30	2.58
21400	0.97	13.75	1.95	64.60	58.78	....	7.63	2.19	0.56	4.88
21125	0.59	14.94	1.85	65.49	59.12	....	5.07	1.31	0.67	3.09
21300	0.87	15.62	1.63	64.95	58.39	....	6.86	1.00	0.74	5.12
21301	0.80	16.12	1.67	64.16	59.23	....	5.79	1.19	0.91	3.69
21240	0.57	17.12	1.78	63.83	56.59	....	8.76	1.06	1.20	6.50
21189	0.78	15.81	1.91	64.10	59.74	....	6.50	0.81	0.92	4.77
21224	0.92	15.94	1.93	64.43	56.70	....	7.14	0.56	0.97	5.61
20942	0.70	14.25	1.87	64.88	59.01	....	8.21	1.81	0.57	5.83
21165	0.92	16.50	2.00	64.01	57.99	....	5.86	1.56	1.06	3.24
21369	1.65	9.31	1.72	73.28	63.62	....	9.35	3.06	1.29	5.00
21686	0.54	12.81	0.77	74.45	69.58	....	5.03	1.06	0.45	3.52
20963	0.15	11.50	0.55	73.79	71.10	....	6.79	2.81	0.31	3.67
21377	0.30	12.81	0.78	72.35	66.21	....	7.23	2.69	0.58	3.96
21018	0.06	10.75	0.56	75.10	71.72	....	6.76	2.81	0.48	3.67
21019	0.07	10.00	0.57	75.89	71.19	....	6.10	2.75	0.33	3.02
21009	0.14	11.12	0.54	73.25	70.99	....	8.34	3.06	0.29	4.99
21095	1.04	13.75	1.36	72.84	53.49	....	17.00	1.75	1.00	14.25
20996	0.11	11.50	0.48	75.83	74.08	....	4.75	1.00	0.20	3.55
21190	1.12	11.87	1.41	71.52	64.41	....	7.87	2.31	1.16	4.40
20997	0.14	10.25	0.50	74.98	71.10	....	6.34	2.44	0.30	3.60
20972	0.64	11.25	0.70	74.19	69.75	....	6.79	1.19	0.65	4.95
21001	2.00	9.12	1.70	74.95	64.01	....	10.80	1.19	0.87	*8.74
21166	1.00	10.37	1.67	72.55	61.20	....	11.42	2.25	1.06	8.11
21299	0.04	6.94	1.52	79.91	60.19	0.74	23.06	0.81	1.17	*21.08
20998	0.17	6.62	2.20	78.55	61.31	1.39	30.50	0.50	2.00	*28.00
21128	0.10	7.44	2.16	77.90	66.32	1.11	15.70	0.56	1.68	*13.46
20999	0.21	6.56	1.78	79.52	53.94	0.96	29.37	0.00	1.52	*27.85
21183	0.01	6.75	1.30	79.96	68.34	0.51	28.35	0.50	1.28	*26.57
21028	0.16	6.37	2.72	78.85	55.52	1.90	29.17	0.69	2.10	*26.38

* Soluble starch present.

TABLE II.—BREAKFAST FOODS. PRICES,

Station No.	Brand.	Net weight ounces.	Price in cents. Per package.	Per pound.	Water.	Ether Extract.
	Rice Preparations.					
21000	Cook's Flaked Rice	15.1	12	12.7	12.60	0.12
21126	Cook's Malto-Rice	17.2	8	7.4	11.30	0.15
21381	Milk Rice	7.7	10	20.8	12.33	0.15
21020	Quaker Puffed Rice	7.5	10	21.3	12.22	0.16
	Wheat Preparations.					
21184	Holland Rusk	6.7	10	23.8	10.99	5.14
21039	Triscuit	13.0	10	12.3	10.27	1.38
21280	Shredded Whole Wheat	13.4	12	14.3	8 52	1.43
21282	Zest	11.5	9	12.5	10.67	1.21
21181	Force	12.9	15	18.6	10.68	1.14
21182	Mapl-Flake	11.1	15	21 6	10.82	1.22
21096	Quaker Wheat Berries	7.9	10	20.3	9.75	2.00
21191	Quaker Wheat Berries	6.5	10	24.6	10.25	1.86
21034	Grape-Nuts	16.5	12	11.5	10.34	0.63

Water-Soluble Matter. Weigh 6 gms. of substance into a 200 cc. flask, fill to the mark with water, adding a few drops of chloroform; shake at half-hour intervals for eight hours, then allow to stand for sixteen hours longer. Filter, pipette 100 cc. of filtrate into a tared dish and evaporate to apparent dryness on the water bath. Dry to constant weight in air bath under 90° C. Determine ash in the dried extract in the usual way. In another 100 cc. portion of the filtrate determine the soluble protein, (or protein may be determined in the well-washed residue from the first filtration).

DISCUSSION OF THE ANALYSES.

The average composition of the several groups of breakfast foods, calculated from our analyses, is as follows:

	Water.	Fat.	Fiber.	Protein.	Ash.	Nitrogen-Free Extract.
Ready to serve.						
Corn	11.70	0.34	0.12	6.78	1.75	79.31
Rice	12.11	0.14	0.17	7.47	1.04	79.07
Wheat	10.25	1.78	1.33	11.33	1.82	73.49
To be cooked.						
Barley	12.12	0.89	0.26	9.50	0.96	76.27
Corn	12.33	1.10	0.26	8.02	0.49	77.80
Oat	10.78	6.53	0.79	15.56	1.84	64.50
Wheat	11.90	1.41	0.64	11.17	0.95	73.93

WEIGHTS AND ANALYSES.—*Continued.*

Station No.	Crude Fiber.	Protein (N x 6.25).	Ash.	Nitrogen-Free Extract.	Starch.	Chlorin as Sodium Chlorid.	Water Extract. Total.	Protein.	Ash.	Carbohydrates.
21000	0.22	7.81	0.35	78.90	78.24	....	4.17	0.00	0.15	*4.12
21126	0.07	7.62	0.57	80.29	74.13	....	9.46	0.94	0.21	8.31
21381	0.24	6.87	3.19	77.22	62.60	2.51	33.70	0.56	2.83	*30.31
21020	0.14	7.56	0.39	79.53	61.76	....	31.92	2.69	0.20	*29.03
21184	0.04	12.06	1.31	70.46	55.80	....	16.55	1.06	1.15	14.34
21039	1.74	11.00	1.73	73.88	60.75	....	10.10	1.00	1.03	*8.07
21280	2.57	11.00	1.53	74.95	63.06	....	9.50	1.06	1.10	*7.34
21282	1.24	9.00	2.59	75.29	60.08	0.36	35.29	1.19	2.05	*32.05
21181	1.14	10.62	2.75	73.67	59.85	0.48	12.79	1.44	1.95	*9.40
21182	1.21	9.25	2.80	74.70	58.28	0.54	16.16	1.19	2.45	*12.52
21096	1.17	14.00	1.40	71.68	57.11	....	23.54	3.00	1.25	*19.29
21191	1.38	13.56	1.40	71.55	48.32	....	29.38	3.19	1.28	*24.91
21034	1.45	11.50	1.85	74.23	36.34	0.13	39.20	1.81	1.37	*36.02

* Soluble Starch present.

The chief chemical differences are in the content of fat and protein, the corn foods containing the lowest and the oat products the highest percentages, with the wheat products intermediate. The "ready to serve" foods contain more ash because of the salt added for seasoning purposes.

The fuel value of the various groups is shown below, together with the cost of 100 calories in each:

	Calories per lb. of food.	Cost per 100 Calories—Cts.
Ready to serve.		
Corn	1617	0.85
Rice	1617	0.96
Wheat	1654	1.07
To be cooked.		
Barley	1634	0.55
Corn	1645	0.29
Oat	1766	0.37
Wheat	1611	0.58

Except with the oat foods, where a relatively high figure is obtained, the fuel values show only small differences. However, when the cost per 100 calories is considered, the varieties are

very large and give useful data as to the relative cost of the foods. Again, it is shown that the "ready to serve" preparations are the more expensive, on the average costing more than twice as much as the other foods. In each class the corn foods are the cheapest per calorie and the wheat foods the most expensive.

The amount of water extract measures quite closely the soluble carbohydrates (sugar, dextrin, etc.) present in the foods. It will be seen from the tables that with few exceptions the foods which require cooking contained relatively small amounts of soluble carbohydrates, an average of 4.53 per cent., compared with 19.95 per cent. in the "ready to serve" foods. These differences are mainly due to the partial conversion of starch into dextrin, either by cooking or by the action of various diastatic ferments or yeasts.

The average percentage of water-soluble substances in the two classes of food is:

	Total Food.	Total Protein.	Total Ash.	Total Nitrogen-Free Extract.
Ready to serve	22.5	12.9	86.5	26.1
To be cooked	6.8	13.4	56.6	6.3

The higher solubility of the "ready to serve" foods is very marked, and chiefly affects the nitrogen-free extract. The higher solubility of the ash has little significance, being due to the addition of salt; and furthermore, the total ash in the foods is low, in no case reaching 3 per cent.

The water-soluble carbohydrates added to the starch (water-insoluble) should nearly equal the total nitrogen-free extract. This is not always the case. The difference is greatest in the "ready to serve" foods, and is chiefly due to the presence of soluble starch, which was not determined separately and is included with the water-soluble carbohydrates. For instance, in Milk Rice, Quaker Puffed Rice and Zest, the sum of the two fractions is 92.91, 90.79 and 92.13, while the total nitrogen-free extract is 77.56, 79.53 and 75.62, respectively. All the foods containing soluble starch are designated by an asterisk in the tables.

The range in weight, selling price and cost per pound of material is shown in the following tabulation:

	Weight of Package. Oz.	Price of Package. Cts.	Cost per Pound. Cts.
Ready to serve.			
Corn	8.1–10.8	5–10	9.9–16.5
Average	10.0	8.7	13.8
Rice	7.5–17.2	8–12	7.4–21.3
Average	11.9	10.0	15.6
Wheat	6.5–13.4	9–15	11.5–24.6
Average	11.1	11.4	17.7
To be cooked.			
Barley	17.8	10.0	9.0
Corn	29.9–74.1	6–25	3.1–5.4
Average	40.4	12.2	4.8
Oat	24.2–34.3	10–15	5.7–8.3
Average	28.0	11.6	6.6
Wheat	15.6–31.8	6–25	5.9–18.8
Average	24.1	13.7	9.3

COFFEE.

Twenty-eight samples of coffee were examined, six unground and twenty-two ground. Four of the ground coffees were sold in bulk, the others in packages, and full weight was given in practically every case.

None of the samples examined was found adulterated.

By comparing this result with the station's first examination of coffee in 1896, the great improvement in the purity of this food is clearly shown. In that year, of forty-four samples of unground coffee examined, eleven, or 25 per cent., were adulterated; in the same year, of sixty-five ground coffees, fifty-eight, or 89 per cent., were adulterated.

Below will be found the brands examined this year:

Unground Coffee.

Bower and Bartlett, Boston. Blue Ribbon Brand.
German American Coffee Co., New York. Iowa Brand.
Edwin J. Gillies & Co., New York. Rising Sun.
The Great Atlantic and Pacific Tea Co., New York. Sultana Brand.
Mrs. Mary McGuire, Torrington. Our Own Blend.
R. W. Parrott, Bridgeport. Yoma Blend.

Ground Coffee.

C. S. Allen, Wallingford. Peep O' Day Brand.
John P. Augur, New Haven. Crescent Mill Pure Ground Tiger.
Alexander H. Bill & Co., Boston. Tudor.

Brown, Thomson & Co., Hartford. Special Blend.
Brownell & Field Co., Providence, R. I. Autocrat.
The F. C. Bushnell Co., New Haven. Golden Star.
Chase & Sanborn, Boston. Seal Brand.
Lewis DeGraff & Son, New York. Health Brand.
B. Fischer & Co., New York. Golden Crown.
Fleming & Cowan, Hartford. Our Favorite.
Frey Bros., Torrington. Our Middlesex Brand.
Chas. G. Lincoln & Co., Hartford. Puritan Boy.
W. J. Madigan, Hartford. Butterfly Brand.
G. H. Miller, New London. My Own Brand.
Miner, Read & Garrette, New Haven. Sunrise Breakfast.
John A. Pilgard, Hartford. Old Glory.
United Drug Co., Boston. Symond's Inn.
Thos. Wood & Co., Boston. Coffee.
In bulk:—East India Tea Co., Bridgeport.
Lawlor & Dwyer, Ansonia.
Standard Tea Co., Hartford.
Thomas T Store, New Haven.

CONDENSED MILK.

Thirty-six samples of condensed milk, representing all the brands of both sweetened and unsweetened milk which could be found on sale in the State, have been examined. The names of the brands and their analyses are given in Tables III and IV. A brief summary of this examination follows:

All the samples bought were in apparently sound condition except Dr. Hand's. The can of this brand was swelled and the contents almost solid. It was therefore rejected and another sample obtained.

The statements of weight of contents, where given on the labels, were correct. From the weight of the net contents of each can and its cost is calculated the cost per pound. The costs of sweetened condensed milk range from 8.9 to 22.7 cents per pound, averaging 12.4. The costs of unsweetened condensed milk range from 9.5 to 16.9 cents, the average being 11.5 cents.

Examination of the table of analyses shows no general relation between the composition or degree of concentration of the milk and its price.

Condensed milk is so much used as a substitute for fresh milk, and even for cream, that the relation of the costs of condensed and fresh milk is important. This comparison can best be made

on the basis of the content of fat, which is the most valuable constituent. The sweetened milk contained from 7.94 to 10.06 per cent. of fat, and averaged 9.36 per cent; the unsweetened from 7.20 to 10.20, with an average of 8.66 per cent. One pound of fat cost $1.33 on the average in both the sweetened and unsweetened milks, the range of cost in the former being from 94 cents to $2.69, and in the latter from $1.09 to $1.87. Assuming that one quart of fresh milk weighs 2.25 pounds, and that it contains 4 per cent. of fat, one pound of fat would cost 66 and 89 cents in milks costing the retail buyer 6 and 8 cents respectively. In other words, fat in condensed milk costs from 1.5 to 2 times as much as fat in fresh milk. This increased cost does not seem unreasonable, especially when the cleanliness of the product and the cost of its manufacture are considered. These calculations, however, apply only to the average cost. In certain brands the cost of fat is excessive. For instance, in two brands the condensed milk costs 22.7 and 21.4 cents per pound, making one pound of fat in these brands cost $2.37 and $2.69 respectively, or about four times as much as it would cost in milk selling at 6 cents per quart, and about three times as much as in milk at 8 cents per quart.

The sweetened milk, with five exceptions, meets the legal requirements. In four samples the percentages of fat in the calculated milk solids were abnormally low, although the percentage of fat in the condensed milk was normal. This merely indicates an inversion of cane sugar during condensation, as is explained below. The fifth sample, Dr. Hand's, is made from low grade or partially skimmed milk.

Unsweetened milk should contain *at least* 7.75 per cent. of fat. Van Camp's contained only 7.20 per cent., and Wilson's and Libby's were but slightly above the minimum, and all three contained considerably less milk solids than the standard requires.

The discussion on the following pages shows that if the directions for use given on the labels are followed, the resulting mixtures will contain, in all but one case, only about half as much solids or fat as good cow's milk.

Attention is also called to the composition of human milk at different periods with the prescriptions given for making substitutes by diluting condensed milk, which shows that these

TABLE III.—ANALYSES OF SWEETENED CONDENSED MILK.

Station No.	Brand.	Price per can, cents.	Weight of contents. Found oz.	Weight of contents. Claimed oz.
374	*Baby Brand. Borden's Condensed Milk Co., New York	18	12.7	...
964	*Challenge Brand. Borden's Condensed Milk Co., New York*	10	12.6	...
241	Dairy Brand. Borden's Condensed Milk Co., New York	10	14.9	...
854	Daisy Brand. Borden's Condensed Milk Co., New York	13	15.6	...
069	Defiance Brand. Borden's Condensed Milk Co., New York	10	12.7	...
675	Eagle Brand. Borden's Condensed Milk Co., New York	15	15.9	...
341	Full Weight Brand. Borden's Condensed Milk Co., New York	12	15.6	...
007	*Magnolia Brand. Borden's Condensed Milk Co., New York	10	14.4	...
171	Pine Tree Brand. Borden's Condensed Milk Co., New York	9	14.6	...
097	Thistle Brand. Borden's Condensed Milk Co., New York	10	13.1	...
263	Tip Top Brand. Borden's Condensed Milk Co., New York	12	14.9	...
283	*Champlain Brand. Champlain Condensed Milk Co., Richmond, Vt.	10	14.8	...
052	Emery. Emery Food Co., Chicago	10	11.4	11
654	†Dr. Hands' C. M. with Phosphates and Hypophosphites. The Dr. Hand Condensed Milk Co., Scranton, Pa.	18	13.4	...
284	*Gilead. M. B. & F. S. Hubbell, New Haven	8	14.4	...
375	Star Brand. Michigan Condensed Milk Co., New York	10	14.7	...
011	*Sweet Clover Brand. Mohawk Condensed Milk Co., Rochester, N. Y.*	10	14.8	...
852	Sweet Clover Braud. Mohawk CondensedMilk Co., Rochester, N. Y.	10	14.6	...
967	Grandmother's A. & P. Northern Condensed Milk Co., Philadelphia	9	13.5	...
995	Ruby Brand. The Vermont Condensed Milk Co., Richmond, Vt.	10	13.2	...
866	*Silver Chord. The Vermont Condensed Milk Co., Richmond, Vt.	8	14.4	...
98	Vermont Brand. The Vermont Condensed Milk Co, Richmond, Vt.	10	14.8	...
53	Vermont Brand. The Vermont Condensed Milk Co., Richmond, Vt.	10	14.8	...
35	Vermont Brand. The Vermont Condensed Milk Co., Richmond, Vt.	10	14.9	...
35	Pride of Wayne Brand. Wayne County Condensed Milk Co., Ontario Center, N. Y.	9	13.4	...

*Addition of cane sugar not stated on the label.
†Duplicate sample from G. C. Hamilton, Bridgeport, received in spoiled condition.

dilutions supply very much less of the essential food ingredients than mother's milk, while nearly two-thirds of the nutritive matter may consist of cane sugar.

DISCUSSION OF THE ANALYSES.

The following standards have been adopted for condensed milk:

TABLE III.—ANALYSES OF SWEETENED CONDENSED MILK—*Continued*

Station No.	In Material as sold.								In Milk Solids.			
	Water.	Total Solids.	Cane Sugar.	Milk Solids.	Ash.	Protein (Nx6.38.)	Milk Sugar.	Fat.	Ash.	Protein.	Milk Sugar.	F[illegible]
21374	27.62	72.38	40.61	31.77	1.73	7.91	12.53	9.60	5.44	24.90	39.44	3[illegible]
20964	31.32	68.68	29.22	39.46	1.82	8.10	20.24	9.30	4.61	20.53	51.29	2[illegible]
21241	25.22	74.78	43.42	31.36	1.60	8.10	12.08	9.58	5.10	25.83	38.52	3[illegible]
21854	26.28	73.72	43.45	30.27	1.50	8.17	11.50	9.10	4.96	26.99	37.99	3[illegible]
21069	26.13	73.87	40.91	32.96	1.73	8.47	13.13	9.63	5.25	25.70	39.83	2[illegible]
21675	24.87	75.13	44.03	31.10	1.86	8.04	11.95	9.25	5.98	25.85	38.43	2[illegible]
21341	23.85	76.15	41.00	35.15	1.95	8.80	14.95	9.45	5.55	25.04	42.53	2[illegible]
21007	23.81	76.19	42.11	34.08	1.76	8.80	13.66	9.86	5.16	25.82	40.09	2[illegible]
21171	29.89	70.11	32.97	37.14	1.64	7.98	18.50	9.02	4.42	21.49	49.80	2[illegible]
21097	25.16	74.84	41.12	33.72	1.86	8.10	13.70	10.06	5.52	24.02	40.63	2[illegible]
21263	25.08	74.92	39.94	34.98	1.88	8.29	15.24	9.57	5.37	23.70	43.57	2[illegible]
21283	29.30	70.70	39.11	31.59	1.71	7.85	12.43	9.60	5.41	24.85	39.35	3[illegible]
21052	28.89	71.11	39.23	31.88	1.54	8.61	12.84	8.89	4.83	27.01	40.27	2[illegible]
21654	29.75	70.25	35.34	34.91	1.99	8.43	16.55	7.94	5.70	24.15	47.41	2[illegible]
21284	30.21	69.79	36.75	33.04	1.62	8.10	14.14	9.18	4.90	24.52	42.80	2[illegible]
21375	25.79	74.21	42.36	31.85	1.78	8.49	12.59	8.99	5.59	26.66	39.52	2[illegible]
21011	24.29	75.71	42.97	32.74	1.79	8.74	12.26	9.95	5.47	26.70	37.44	3[illegible]
21852	24.73	75.27	44.05	31.22	1.59	8.42	11.82	9.39	5.09	26.97	37.86	3[illegible]
20967	28.84	71.16	29.64	41.52	1.75	7.91	22.85	9.01	4.21	19.05	55.04	2[illegible]
20995	26.58	73.42	40.68	32.74	1.65	8.23	12.82	10.04	5.04	25.14	39.15	3[illegible]
21866	25.46	74.54	42.33	32.21	1.91	8.49	12.30	9.51	5.93	26.36	38.19	2[illegible]
21098	25.90	74.10	40.97	33.13	1.71	8.36	13.80	9.26	5.16	25.23	41.66	2[illegible]
21853	25.41	74.59	43.56	31.03	1.62	8.23	11.57	9.61	5.22	26.52	37.29	3[illegible]
21635	28.17	71.83	40.54	31.29	1.70	8.43	11.28	9.88	5.43	26.94	36.05	3[illegible]
21035	24.52	75.48	44.83	30.65	1.63	8.36	12.29	8.37	5.32	27.28	40.09	2[illegible]

"*Condensed milk, evaporated milk,* is milk from which a considerable portion of water has been evaporated, and contains not less than twenty-eight (28) per cent. of milk solids, of which not less than twenty-seven and sixty-six hundredths (27.66) per cent. is milk fat."

"*Sweetened condensed milk* is milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has been added, and contains not less than twenty-eight (28) per cent. of milk solids, of which not less than twenty-seven and sixty-six hundredths (27.66) per cent. is milk fat."

TABLE IV.—ANALYSES OF UNSWEETENED CONDENSED MILK.

Station No.	Brand.	Price per can, cts.
21269	Peerless Brand. Borden's Condensed Milk Co., New York	10
21674	Highland Brand. Helvetia Milk Condensing Co., Highland, Ill.	13
21261	Our Pet Brand. Helvetia Milk Condensing Co., Highland, Ill.	10
21150	Wilson's Indiana Condensed Milk Co., Sheridan, Ind.	10
20966	A. & P. Brand. St. Charles Condensing Co., St. Charles, Ill.	10
20965	St. Charles. St. Charles Condensing Co., St. Charles, Ill.	9
20971	Van Camp's. The Van Camp Packing Co., Indianapolis, Ind.	10
21215	Blue Label Brand. Wayne County Condensed Milk Co., Rochester, N. Y.	10
21935	Hylac Brand. The Federal Packing Co., New York	5
22057	Libby's. Libby, McNeill & Libby, Chicago	10
22061	Silver Cow. St. Charles Condensing Co., St. Charles, Ill.	10

The methods of analysis used are given in detail on page 191.

In 1904 this station examined twenty-eight samples of sweetened, and in 1906, eight samples of unsweetened condensed milk. For comparison the averages of those analyses are brought together with those secured this year in the following table:

TABLE V.

AVERAGES.	SWEETENED. 1904. (28 Samples)	SWEETENED. 1909. (25 Samples)	UNSWEETENED. 1906. (8 Samples)	UNSWEETENED. 1909. (11 Samples)
Net weight, oz.	14.0	14.2	11.6	13.9
Cost per can, cents	10.3	10.8	8.5	9.7
Cost per pound, cents	11.8	12.3	11.7	11.5
In original material.				
Water	26.08	26.68	71.85	71.87
Total solids	73.92	73.32	28.15	28.13
Cane sugar	40.32	40.05	.....	.....
Milk solids	33.60	33.27	28.15	28.13
Ash	1.90	1.73	1.68	1.55
Protein	8.77	8.30	7.75	7.57
Milk sugar	14.07	13.88	11.03	10.34
Fat	8.86	9.36	7.69	8.67
In the milk solids.				
Ash	5.68	5.23	5.97	5.51
Protein	26.17	25.09	27.53	26.91
Milk sugar	41.76	41.37	39.18	36.76
Fat	26.39	28.31	27.32	30.82

TABLE IV.—ANALYSES OF UNSWEETENED CONDENSED MILK—*Continued.*

Station No.	Weight of Contents.		In Material as sold.						In Milk Solids.			
	Found oz.	Claimed oz.	Water.	Total Solids.	Ash.	Protein (Nx6.38).	Milk Sugar.	Fat.	Ash.	Protein.	Milk Sugar.	Fat.
21269	15.9	....	69.21	30.79	1.71	8.36	11.45	9.27	5.55	27.15	37.19	30.11
21674	12.4	12	70.60	29.40	1.60	7.85	10.95	9.00	5.44	26.70	37.25	30.61
21261	12.5	12	71.62	28.38	1.63	7.08	10.71	8.96	5.74	24.95	37.74	31.57
21150	15.7	16	75.27	24.73	1.53	6.70	8.75	7.75	6.19	27.09	35.38	31.34
20966	11.9	....	71.54	28.46	1.43	7.66	10.80	8.57	5.02	26.91	37.96	30.11
20965	12.0	....	71.58	28.42	1.34	7.66	10.55	8.87	4.71	26.95	37.13	31.21
20971	16.9	16	74.85	25.15	1.29	6.89	9.77	7.20	5.13	27.39	38.85	28.63
21215	15.8	....	70.98	29.02	1.57	7.53	10.93	8.99	5.41	25.95	37.66	30.98
21935	6.5	....	70.13	29.87	1.70	8.17	9.80	10.20	5.69	27.35	32.81	34.15
22057	16.8	16	74.08	25.92	1.50	7.15	9.39	7.88	5.79	27.58	36.23	30.40
22061	16.5	....	70.86	29.14	1.72	8.17	10.63	8.62	5.90	28.04	36.48	29.58

This comparison shows that the manufacturers are now supplying about the same amount of sweetened milk in their packages as in 1904 at an increased cost of 0.5 cent. They are also supplying about 20 per cent. more unsweetened milk per can at an increased cost of 1.2 cents, so that the cost per pound of the condensed milk is slightly lower than in 1906. The composition of the samples analyzed in 1904 is quite like that of those examined this year, except in fat content, which is higher this year by 0.5 per cent. in the sweetened milk, and nearly 1 per cent. higher in the unsweetened milk. The milk solids are about the same, but the fat in these solids increases by 1.92 per cent. in the sweetened, and by 3.50 per cent. in the unsweetened. These figures indicate that the average condensed milk sold in the Connecticut market is of distinctly higher quality than it was five years ago. The ratio of protein to fat is a useful indication of the quality of the original milk used, a whole milk of good quality usually showing considerable more fat than protein. The above tabulation shows that this ratio has increased from 1.01 to 1.13 in the sweetened milk, and from 0.99 to 1.15 in the unsweetened.

The standards for both kinds of condensed milk require that it shall contain not less than 28 per cent. of milk solids, of which not less than 27.66 per cent. is milk fat. The required percentage of milk solids is based on the analysis of a large number of

samples of condensed milk, and the percentage of milk fat in those solids is derived from the Government standard for milk, *viz.*, 3.25 per cent. of fat and 11.75 per cent. total solids. Such milk is by no means a high-grade milk, and there can be no difficulty in maintaining the required proportion of fat, provided the manufacturer uses only whole milk in his factory. This fact is clearly shown by the following tabulation, in which are given the analyses of typical milk from the United States,

TABLE VI.—AVERAGE COMPOSITION OF COW'S MILK.

Authority.	Total Solids.	Fat.	Solids not Fat.	Per Cent. of Fat in Solids.
English (Richmond, 1906)	12.70	3.73	8.97	29.37
" (Richmond, 1907)	12.64	3.71	8.93	29.35
" (Richmond, 1908)	12.69	3.75	8.94	29.56
" (Vieth)	12.90	4.10	8.80	31.78
Canadian (McGill)	12.62	3.80	8.82	30.11
German (Koenig)	12.83	3.69	9.14	28.76
German (Fleischmann)	12.25	3.40	8.85	27.25
Dutch (Fleischmann)	12.00	3.25	8.75	27.08
American (Van Slyke)	12.90	3.90	9.00	30.23
" (Van Slyke, cheese factory)	12.60	3.75	8.85	29.76
" (Voorhees, Ayrshire)	12.70	3.68	9.02	29.05
" (Voorhees, Guernsey)	14.48	5.02	9.46	34.66
" (Voorhees, Holstein)	12.12	3.51	8.61	28.96
" (Voorhees, Jersey)	14.34	4.78	9.56	33.33
" (Voorhees, Shorthorn)	12.45	3.65	8.80	29.32

Canada and several European countries. In every case they represent the average of a large number of analyses.

With the exception of Fleischmann's analyses of typical low-grade German and Dutch milks, these analyses, representing about 200,000 samples of milk, show that a requirement of 27.66 per cent. of fat in the solids is considerably lower than that found in average milk. Voorhees' analyses of the milk of pure bred cows show that the fat ratio increases with the high fat content of Guernsey and Jersey milk, in the latter reaching 34.66 per cent. Van Slyke's figures represent a compilation of the analyses of 5,552 samples of American milk, and probably reflect more accurately the true market conditions in this country. In these the fat makes up 30.23 per cent. of the solids.

It will be seen from our tables of analyses that the fat in the milk solids in the unsweetened condensed milk ranged from 28.63 to 34.15 per cent., with an average of 30.82 per cent., while in the sweetened milk it ranged from 21.70 to 31.58 per

cent., with an average of 28.31 per cent. The unsweetened milks in every case exceeded the standard requirement in this respect, while the average agreed very closely with Van Slyke's figures. In the sweetened milk, however, we find four samples showing only 23.57, 24.29, 22.74 and 21.70 per cent. of fat in the milk solids, and yet their fat content is 9.30, 9.02, 7.94 and 9.01, respectively, all except the third, indicating condensed milk of good quality. It will be noted, also, that these same four samples have abnormally high percentages of lactose, 20.24, 18.50, 16.55 and 22.85 per cent., respectively, and that the milk solids are correspondingly high and the cane sugar correspondingly low. This is no doubt due to a partial inversion of the cane sugar during condensation, so that the method used for determining lactose in the finished product gives the sum of the lactose and of the invert sugar calculated as lactose. It is quite possible that inversion of cane sugar in all samples may increase the calculated amount of lactose and hence diminish the ratio of fat solids.

Omitting these four samples, the average for sweetened milk is 32.32 per cent. milk solids, 9.47 per cent. fat and 29.31 per cent. of fat in the milk solids. Assuming this average of 32.32 per cent. for the milk solids of the four brands in question, the percentages of fat in the milk solids would be 28.77, 27.91, 24.57 and 27.88 respectively, all reaching the standard satisfactorily with the exception of the third, which appears to have been manufactured from a low-grade milk.

The standard requires a minimum of 7.75 per cent of fat $(28 \times 27.66 = 7.75)$. In the sweetened milks the fat ranged from 7.94 to 10.06, with an average of 9.36 per cent.; in the *unsweetened from 7.20 to 10.20, with an average of 8.67 per* cent. All the sweetened milks satisfied this standard, only one, Dr. Hand's, closely approaching the minimum. In the unsweetened milks, Van Camp's contained only 7.20 per cent. of fat, Wilson's exactly equaled the minimum, 7.75 per cent., and Libby's contained only 7.88 per cent., slightly above the minimum. These three samples were likewise deficient in milk solids, containing 24.73, 25.15 and 25.92 per cent. respectively.

Degree of Condensation.

The composition of a condensed milk depends not only upon the quality of the milk condensed, but also on the amount of

this condensation. In sweetened condensed milk the concentration is carried much further than in the unsweetened variety. It is important to determine the degree of condensation, as thereby a good idea may be obtained as to the composition of the original milk. The calculation of this factor is a comparatively easy matter in the case of unsweetened milk, for here we are dealing with the normal constituents of milk, and, excepting water, in normal proportions. In sweetened milk, however, containing varying amounts of cane sugar, the whole relation of the constituent solids is changed and the problem is much more complicated.

Various methods of calculation have been devised for this purpose, which give approximately correct results. The amount of ash is very constant in milks of widely different origin, seldom varying much from 0.7 per cent. Accordingly, if the percentage of ash found in an unsweetened condensed milk be divided by 0.7, the quotient represents quite accurately the degree of condensation. This method is also applicable to sweetened milks, although here, of course, it is necessary to reduce the ash to a cane-sugar-free basis before making the division.

The amount of solids-not-fat also is a comparatively constant factor in milk, especially in the milk of the average American herd. As a rule, however, the solids-not-fat increases somewhat with the solids and the fat. For instance, Voorhees' figures on page 182, for pure-bred cows, show a variation from 8.61 for Holsteins to 9.56 for Jerseys. Authorities differ, therefore, on the proper figure to assume for solids-not-fat. The Federal standard, and that of several of the states, requires 8.5 per cent., and that being the standard, would be a reasonable factor to apply. Others have suggested 8.9 per cent. as representing average American milk; while still others suggest 9.3 per cent., as being the highest figure likely to be shown by the milk of mixed herds, and therefore giving the manufacturer the benefit of every doubt. The writer suggests still another method, based on the percentage of lactose. The analyses made by Voorhees of the milk of pure-bred Ayrshire, Guernsey, Holstein, Jersey and Shorthorn cows show a remarkable constancy in this ingredient, the averages being 4.84, 4.80, 4.69, 4.85 and 4.80, respectively. Accordingly, the factor 4.8 for lactose has been applied to

TABLE VII. DEGREE OF CONDENSATION.

Sweetened.

Brand.	Times Condensed. Calculation based on				Calculated Fat in Original Milk.				Ratio Protein to fat 1 :
	.7 per cent. Ash	8.5 per cent. Solids not fat	8.9 per cent. Solids not fat	9.3 per cent. Solids not fat	.7 per cent. Ash	8.5 per cent. Solids not fat	8.9 per cent. Solids. not fat	9.3 per cent. Solids not fat	
Baby	4.16	4.39	4.19	4.01	3.88	3.68	3.85	4.03	1.21
*Challenge	3.67	5.01	4.78	4.58	3.58	2.62	2.74	2.87	1.14
Dairy	4.04	4.53	4.33	4.14	4.19	3.74	3.92	4.09	1.18
Daisy	3.79	4.40	4.20	4.03	4.25	3.66	3.83	3.99	1.11
Defiance	4.19	4.64	4.43	4.25	3.89	3.52	3.69	3.84	1.14
Eagle	4.74	4.59	4.38	4.20	3.49	3.60	3.77	3.94	1.15
Full Weight	4.73	5.12	4.89	4.68	3.39	3.13	3.28	3.42	1.08
Magnolia	4.34	4.92	4.70	4.50	3.92	3.46	3.62	3.79	1.12
*Pine Tree	3.50	4.94	4.72	4.51	3.85	2.72	2.85	2.98	1.13
Thistle	4.51	4.73	4.52	4.32	3.79	3.61	3.78	3.96	1.24
Tip Top	4.47	4.98	4.76	4.55	3.56	3.20	3.35	3.40	1.15
Champlain	4.01	4.25	4.06	3.88	3.93	3.71	3.88	4.06	1.22
Emery	3.61	4.45	4.25	4.07	4.05	3.29	3.44	3.59	1.03
Dr. Hand's	4.40	4.91	4.69	4.48	2.79	2.50	2.62	2.74	0.94
Gilead	3.46	4.19	4.00	3.83	3.96	3.27	3.42	3.58	1.13
Star	4.41	4.66	4.45	4.26	3.54	3.35	3.51	3.66	1.05
Sweet Clover	4.49	4.70	4.49	4.30	3.89	3.71	3.88	4.05	1.14
" "	4.06	4.59	4.38	4.20	4.13	3.66	3.83	4.00	1.12
*Grandmother's	3.56	5.44	5.20	4.97	3.60	2.35	2.46	2.58	1.14
Ruby	3.97	4.50	4.30	4.12	4.21	3.76	3.94	4.11	1.22
Silver Chord	4.73	4.63	4.42	4.23	3.49	3.56	3.73	3.90	1.12
Vermont	4.14	4.76	4.55	4.35	3.79	3.30	3.46	3.61	1.11
"	4.10	4.47	4.27	4.08	4.15	3.81	3.99	4.17	1.17
"	4.09	4.24	4.05	3.87	4.06	3.92	4.10	4.29	1.17
Pride of Wayne	4.23	4.75	4.54	4.34	3.59	3.19	3.34	3.50	1.00
Average	4.23	4.61	4.40	4.21	3.82	3.48	3.65	3.80	1.13

*Omitted from average for reasons stated on page 183.

TABLE VIII. DEGREE OF CONDENSATION.

Unsweetened.

Brand.	Times Condensed. Calculation Based on					*Calculated Fat in Original Milk.*					Ratio Protein to fat 1 :
	.7 per cent. Ash	8.5 per cent. Solids not fat	8.9 per cent. Solids not fat	9.3 per cent. Solids not fat	4.8 per cent. Milk Sugar	.7 per cent. Ash	8.5 per cent. Solids not fat	8.9 per cent. Solids not fat	9.3 per cent. Solids not fat	4.8 per cent. Milk Sugar	
Peerless	2.44	2.52	2.41	2.31	2.39	3.80	3.68	3.85	4.01	3.88	1.11
Highland	2.29	2.40	2.29	2.19	2.28	3.93	3.75	3.93	4.11	3.95	1.15
Our Pet	2.33	2.28	2.18	2.09	2.23	3.85	3.93	4.11	4.29	4.02	1.27
Wilson's	2.19	2.00	1.91	1.83	1.82	3.54	3.88	4.06	4.23	4.26	1.16
A. and P.	2.04	2.34	2.23	2.14	2.25	4.20	3.66	3.84	4.00	3.81	1.12
St. Charles	1.91	2.30	2.20	2.10	2.20	4.64	3.86	4.03	4.22	4.03	1.16
Van Camp's	1.84	2.11	2.02	1.93	2.04	3.91	3.41	3.56	3.73	3.53	1.05
Blue Label	2.24	2.36	2.25	2.15	2.28	4.01	3.81	3.99	4.18	3.94	1.19
Hylac	2.43	2.31	2.21	2.12	2.04	4.20	4.42	4.62	4.81	5.00	1.25
Libby's	2.14	2.12	2.02	1.94	1.96	3.68	3.72	3.90	4.06	4.07	1.10

the unsweetened milks analyzed; it is not applicable to the sweetened milks with our present methods of analysis.

These methods have been employed in computing Tables VII and VIII, and a useful comparison is thereby furnished.

For the reasons already stated (see page 183), the Challenge, Pine Tree and Grandmother's brands are omitted in this consideration. The table shows the wide variations arising from the different methods of calculation in the sweetened milk. These are summarized as follows:

SWEETENED MILK.

	TIMES CONDENSED.	
Calculation based on		
0.7% ash	3.46–4.74	Ave. 4.23
8.5% solids-not-fat	4.19–5.12	" 4.61
8.9% " " "	4.00–4.89	" 4.40
9.3% " " "	3.83–4.68	" 4.21
	FAT IN ORIGINAL MILK.	
Calculation based on		
0.7% ash	2.79–4.25	" 3.82
8.5% solids-not-fat	2.50–3.92	" 3.48
8.9% " " "	2.62–4.10	" 3.65
9.3% " " "	2.74–4.29	" 3.80

The closest agreement is shown between the 0.7 per cent. ash basis and 9.3 per cent. solids-not-fat. However, as the latter figure is applicable only to the highest grade of milk, which is probably seldom used in condensaries, it would appear that the ash basis also gives too high a degree of condensation in sweetened milks. On the whole, the basis of 8.9 per cent. of solids-not-fat seems to supply the fairest data whereby to judge the quality of a milk. Whatever basis is used, the Dr. Hand brand is shown to be made from a milk of poor quality, probably skimmed, the fat in the original milk, calculated by the four methods, being 2.79, 2.50, 2.62 and 2.74 per cent., respectively. In the other brands none of the methods of calculation used indicates the use of a milk below the standard quality (3.25 per cent. of fat), except in three cases, where one of the methods gives figures slightly below the standard.

With the unsweetened milks any of the methods gives satisfactory results. The variations are much smaller and the averages are remarkably close, as the following tabulation shows:

UNSWEETENED MILK.

	TIMES CONDENSED.	
Calculations based on		
0.7% ash	1.84–2.46	Ave. 2.21
8.5% solids-not-fat	2.11–2.52	" 2.29
8.9% " " "	1.91–2.41	" 2.18
9.3% " " "	1.83–2.31	" 2.09
4.8% milk sugar	1.82–2.39	" 2.15
	FAT IN ORIGINAL MILK.	
Calculation based on		
0.7% ash	3.50–4.64	" 3.93
8.5% solids-not-fat	3.41–4.42	" 3.79
8.9% " " "	3.56–4.62	" 3.97
9.3% " " "	3.73–4.81	" 4.13
4.8% milk sugar	3.53–5.00	" 4.04

Here again the 9.3 per cent. solids-not-fat gives apparently high results, and the 8.9 per cent. seems to afford the most satisfactory working basis for comparison. All the milk used in the unsweetened brands was above the standard quality.

The Uses and Applications of Condensed Milk.

The labels of most of the brands of condensed milk give directions for its use as a drink, alone or with tea or coffee, as a cooking adjunct, or as a food for infants. It is interesting and important to know just what sort of a product will be supplied by following these directions. Table IX has been calculated from the actual analyses to show the mixture obtained for general use when prepared exactly as directed on the label. In the case of alternative proportions of water, *i. e.*, 3 or 4 parts to 1 of milk, the average, in this case, 3.5, has always been taken. No directions were given with seven brands of the sweetened and with six brands of the unsweetened, so they are of course omitted from this tabulation. Of the sweetened milks, the Emery brand is the only one that would yield, according to directions, a milk containing normal quantities of milk solids and fat, and even this would contain a great excess of cane sugar. The other sweetened milks would yield products containing from 5.5 to 8.8 per cent. of milk solids, and from 1.5 to 2.2 per cent. of fat; in other words, a mixture only a little over half as rich as milk of good quality. None of the brands can be diluted with more than 1.5 parts of water to one of milk and yield a product which equals fresh milk in fat content.

In the unsweetened milks, the Blue Label brand alone yields product approaching good milk in richness. A dilution of part of milk with 3 parts of water can yield a milk of standar composition in none of the unsweetened milks.

TABLE IX.—COMPOSITION OF MIXTURES OF CONDENSED MIL AND WATER PREPARED AS DIRECTED FOR GENERAL USE.

Station No.	Brand.	Proportion of Milk to Water.	Water.	Milk Solids.	Cane Sugar.	Ash.	Protein.	Milk Sugar.	Fat.
	Sweetened.								
20964	Challenge	1 to 3 or 4.	84.7	8.8	6.5	0.4	1.8	4.5	2.1
21241	Dairy	1 to 3 or 4.	83.4	7.0	9.6	0.4	1.8	2.7	2.1
21854	Daisy	1 to 4 or 5.	86.6	5.5	7.9	0.3	1.5	2.0	1.7
21069	Defiance	1 to 3 or 4.	83.6	7.3	9.1	0.4	1.9	2.9	2.1
21341	Full Weight	1 to 3 or 4.	83.1	7.8	9.1	0.4	2.0	3.3	2.1
21007	Magnolia	1 to 3 or 4.	83.1	7.5	9.4	0.4	1.9	3.0	2.2
21171	Pine Tree	1 to 4 or 5.	87.2	6.8	6.0	0.3	1.5	3.4	1.6
21097	Thistle	1 to 3 or 4.	82.4	7.5	9.1	0.4	1.8	3.1	2.2
21263	Tip Top	1 to 3 or 4.	83.4	7.7	8.9	0.4	1.8	3.4	2.1
21052	Emery	1 to 1 or 2.	71.6	12.7	15.7	0.6	3.4	5.1	3.6
21654	Dr. Hand's	1 to 4 or 5.	87.2	6.4	6.4	0.4	1.5	3.0	1.5
21011	Sweet Clover	1 to 4.	84.8	6.6	8.6	0.4	1.7	2.5	2.0
20967	Grandmother's	1 to 4.	85.7	8.4	5.9	0.4	1.6	4.6	1.8
20995	Ruby	1 to 3 or 4.	83.7	7.3	9.0	0.4	1.8	2.9	2.2
21098	Vermont	1 to 3 or 4.	83.5	7.4	9.1	0.4	1.8	3.1	2.1
21853	"	1 to 3 or 4.	83.4	6.9	9.7	0.4	1.8	2.6	2.1
21635	"	1 to 3 or 4.	84.0	7.0	9.0	0.4	1.9	2.5	2.2
21035	Pride of Wayne	1 to 3 or 4.	83.2	6.8	10.0	0.4	1.9	2.7	1.8
	Unsweetened.								
21150	Wilson's	1 to 1 or 2.	90.1	9.9	....	0.6	2.7	3.5	3.1
20965	St. Charles	1 to 3.	92.9	7.1	....	0.4	1.9	2.6	2.2
20971	Van Camp's	1 to 1 or 2.	89.9	10.1	....	0.5	2.8	3.9	2.9
21215	Blue Label	1 to 1 or 2.	88.4	11.6	....	0.6	3.0	4.4	3.6
22057	Libby's	1 to 3.	93.5	6.5	....	0.4	1.8	2.3	2.0

For cooking purposes and for a beverage, deficiency in fat may be of comparatively minor importance, although the nourishing qualities of the milk are thereby reduced. In infant feeding, however, where fat is the most essential ingredient in the milk, and where cane sugar, in the opinion of many physiologists, is especially to be avoided, the composition of the milk obtained by following the manufacturer's directions is of the greatest importance. Condensed milk is largely used for feeding infants and young children, and it is exceedingly important that the parents should not be misled by erroneous directions.

TABLE X.—COMPOSITION OF MIXTURES FOR INFANT FEEDING PREPARED AS DIRECTED.

Station No.	Brand and Age of Infant	Proportion of Milk to Water.	Water.	Milk Solids.	Cane Sugar.	Ash.	Protein.	Milk Sugar.	Fat.
	First Week.								
21150	Wilson's	½ teaspo'nf'l Milk, ¼ " Sugar, 1 oz. Water	95.47	1.50	3.03	0.09	0.41	0.53	0.47
21215	Blue Label	"	95.21	1.76	3.03	0.09	0.46	0.66	0.55
21261	Our Pet	"	95.25	1.72	3.03	0.10	0.43	0.65	0.54
21674	Highland	"	95.19	1.78	3.03	0.10	0.48	0.66	0.54
	Average		**95.28**	**1.69**	**3.03**	**0.10**	**0.45**	**0.62**	**0.52**
	One Month.								
21011	Sweet Clover	1 to 13.	94.59	2.34	3.07	0.13	0.62	0.88	0.71
20965	St. Charles	1 to 6 or 7.	96.21	3.79	--	0.18	1.02	1.41	1.18
20967	Grandmother's	1 to 13.	94.92	2.96	2.12	0.13	0.56	1.63	0.64
21654	Dr. Hand's	1 to 14 or 16.	95.61	2.18	2.21	0.12	0.53	1.03	0.50
21374	Baby	1 to 14 or 16.	95.48	1.98	2.54	0.11	0.49	0.78	0.60
21675	Eagle	1 to 14 or 16.	95.30	1.95	2.75	0.12	0.50	0.75	0.58
	Average		**95.35**	**2.53**	**2.12**	**0.13**	**0.62**	**1.08**	**0.70**
	Two Months.								
21011	Sweet Clover	1 to 11.	93.69	2.73	3.58	0.15	0.73	1.02	0.83
20965	St. Charles	1 to 5 or 6.	95.63	4.37	--	0.21	1.18	1.62	1.36
20967	Grandmother's	1 to 11.	94.07	3.46	2.47	0.15	0.66	1.90	0.75
21654	Dr. Hand's	1 to 12 or 14.	94.99	2.49	2.52	0.14	0.60	1.18	0.57
21374	Baby	1 to 12 or 14.	94.82	2.28	2.90	0.12	0.57	0.90	0.69
21675	Eagle	1 to 12 or 14.	94.63	2.22	3.15	0.13	0.57	0.86	0.66
	Average		**94.64**	**2.93**	**2.43**	**0.15**	**0.72**	**1.25**	**0.81**
	Three Months.								
21011	Sweet Clover	1 to 10.	93.12	2.97	3.91	0.16	0.79	1.11	0.91
20967	Grandmother's	1 to 10.	93.53	3.78	2.69	0.16	0.72	2.08	0.82
21374	Baby	1 to 10 or 12.	93.97	2.64	3.39	0.14	0.66	1.04	0.80
21675	Eagle	1 to 10 or 12.	93.74	2.59	3.67	0.16	0.67	0.99	0.77
	Average		**93.59**	**3.00**	**3.41**	**0.15**	**0.71**	**1.31**	**0.83**
	Three to Six Months.								
21654	Dr. Hand's	1 to 8 or 10.	92.98	3.49	3.53	0.20	0.84	1.66	0.79
	Six Months.								
21011	Sweet Clover	1 to 9.	92.43	3.27	4.30	0.18	0.87	1.23	0.99
20967	Grandmother's	1 to 9.	92.88	4.16	2.96	0.18	0.79	2.29	0.90
	Average		**92.65**	**3.72**	**3.63**	**0.18**	**0.82**	**1.76**	**0.95**
	Six to Twelve Months.								
21654	Dr. Hand's	1 to 6 or 8.	91.22	4.36	4.42	0.25	1.05	2.07	0.99
	One Year.								
21011	Sweet Clover	1 to 6.	89.18	4.68	6.14	0.26	1.25	1.75	1.42
20965	St. Charles	1 to 3.	92.90	7.10	--	0.33	1.91	2.64	2.22
20966	A. and P.	1 to 3 or 4.	93.68	6.32	--	0.32	1.70	2.40	1.90
20967	Grandmother's	1 to 6.	89.84	5.93	4.23	0.25	1.13	3.26	1.29
21374	Baby	1 to 6 or 7.	90.35	4.23	5.42	0.23	1.05	1.67	1.28
21675	Eagle	1 to 6 or 7.	89.99	4.14	5.87	0.25	1.07	1.59	1.23
	Average		**90.99**	**5.40**	**3.61**	**0.27**	**1.35**	**2.22**	**1.56**
	Ten to Twelve Months.	(10 teasp'nful Milk							

A number of the brands give specific directions for the preparation of mixtures suitable for infants from one week to one year old. The composition of these mixtures has been calculated and grouped according to the age of the child for whom they are intended (Table X).

It is a well-known fact that the composition of human milk changes greatly with the period of lactation, the first milk, the colostrum, being very rich in nitrogenous bodies and relatively deficient in milk-sugar; after six months the composition becomes relatively constant. The following analyses made by Camerer and Söldner (*Zeit. Biol.*, 1898, **36**, 277) indicate these variations in composition:

ANALYSES OF HUMAN MILK.

Days after birth of child.	No. of Analyses.	Total Solids.	Ash.	*Protein*, (N x 6.38).	Milk Sugar, (Water-free).	Fat.
1-3 (Colostrum)	4	12.65	0.41	3.25	4.96	2.92
5-6	3	12.09	0.30	1.83	5.83	3.26
8-12	10	12.12	0.28	1.73	6.16	3.11
20-40	15	12.48	0.22	1.30	6.52	3.91
60-140	14	11.79	0.19	1.10	6.81	3.31
170 and over	10	11.44	0.18	0.94	6.78	3.20

A comparison of the calculated composition of the mixtures made for infants of different ages, according to the directions indicated, with the composition of human milk at the same age periods, shows how deficient a diet, as compared with mother's milk, is furnished if the manufacturer's directions are followed. This criticism applies to every brand in the table, for in no case do they even approximate the composition of human milk in all the ingredients. Nor could this condition with the sweetened milk be remedied entirely even by the addition of cream, cod liver oil or some similar oil, and milk sugar, for there will always be an excess of cane sugar present, even when its addition is not specifically directed. The desirability of the presence of cane sugar in the diet of very young children is a matter of much controversy among physiologists, yet each of the four brands of unsweetened milk, which recommend a formula for infants one week old, directs that cane sugar shall be added, making up

nearly two-thirds of the solids of the mixture. The following summary shows the average relation of these mixtures to human milk at the period specified.

Age of child.	Relation of Condensed Milk Mixture to Human Milk.			
	Ash.	Protein.	*Milk Sugar.	Fat.
1 week	1/8	1/4	1/9	1/6
1 month	1/2	1/2	1/6	1/5
3 months	3/4	2/3	1/5	1/4
6 months	O. K.	O. K.	1/4	3/10
1 year	+	+	1/3	1/2

* Cane sugar present in excessive amounts in nearly every individual case.

Methods of Analysis.

1. *Preparation of Sample.* Weigh the can and contents. Transfer the entire contents of the can to a 2-liter flask with water, and make to the mark (Solution A). (This gives an approximately 20 per cent. solution of the milk.) The weight of the dried can subtracted from that of the original package gives net weight of the milk.

2. *Total Solids.* Pipette 5 cc. of Solution A into a tared flat-bottomed aluminum dish, wash out pipette into the dish, and dilute to about 25 cc. with water. Heat on a boiling water bath for two hours, then to constant weight in a water oven at 100° C., cooling in a desiccator.

3. *Ash.* Evaporate 5 cc. of Solution A in a platinum dish, ignite the residue, cool and weigh in the usual manner.

4. *Protein.* Determine nitrogen by the Kjeldahl method in 5 cc. of Solution A, and multiply by 6.38.

5. *Lactose.* Dilute 40 cc. of Solution A in a 500 cc. flask to about 200 cc., add 10 cc. of the Fehling copper sulphate solution and 1.8 cc. of two-thirds normal potassium hydroxid; make up to 500 cc. with water, shake and filter. In a 350 cc. beaker mix 25 cc. of the copper sulphate solution and 25 cc. of the alkaline tartrate solution, add 50 cc. of water and heat to boiling, then add 100 cc. of the filtered milk solution and boil for two minutes. Collect the copper suboxide on a tared Gooch crucible in the usual manner, dry at 100° C. and weigh.

6. *Sucrose.* Determine by difference, deducting the milk solids (lactose + protein + fat + ash) from the total solids.

7. *Fat—Centrifugal Method.* Measure 25 cc. of Solution A into a Babcock test bottle, rinsing out the pipette with a little water. Add 4 cc. of Fehling's copper solution, shake gently and allow to stand for some minutes, or until coagulation is complete. Fill to the neck with water

and whirl in the centrifuge for three or four minutes, or until the supernatant liquid becomes clear and the coagulum a compact mass. Decant the supernatant liquid, filtering through a funnel fitted with a small piece of cotton, which may be used for the subsequent filtrations as well. Add more water to the coagulum in the bottle and shake until all is in suspension. Fill to neck with water and whirl as before, decanting and filtering as before, and repeat this operation once more. Introduce the cotton and any adhering coagulum into the bottle, pushing the cotton down by a stirring rod and thereby cleaning the neck of the bottle. Dilute with water to about 17.6 cc. and add 17.5 cc. of sulphuric acid (Babcock strength). *Shake very thoroughly for four or five minutes (this being* essential to obtain a clear fat column). Proceed as in the regular Babcock method, placing the bottles in a bath at 70-75° for a few minutes before reading. The fat reading multiplied by 18 and divided by the weight of material taken equals per cent. of fat in the sample.

Roese-Gottlieb Method. Measure 10 cc. of Solution A into the tube, rinsing the pipette with about 1 cc. of water. Add 1 cc. of strong ammonia and mix thoroughly. Add about 10 cc. of 92 per cent. alcohol, the total volume in tube at this point being a little less than 22 cc., to enable supernatant ethers to be drawn off later. Mix contents thoroughly and add 30 cc. of absolute ether, again shaking for four or five minutes, *allowing the liquid to run from end to end of the tube.* Then add 30 cc. of petrolic ether (B. P. 30°-40°), and shake thoroughly for one minute. Allow to settle for from fifteen to thirty minutes. Draw off as much of supernatant liquid as possible (all except about 1 cc.), and repeat operation of adding ether, shaking, petrolic ether and again shaking, exactly as before. Draw off the solvent and repeat the operation a third time. Collect the solvent in a tared flask, evaporate at gentle heat over hot air current or over a steam pipe, the last traces being blown out by a current of air forced through cotton to exclude dust. Dry at 100° for about thirty minutes and weigh.

Comparison of Fat Methods.

All the samples were tested for fat in duplicate by both the Babcock-Leach (centrifugal) and the Roese-Gottlieb methods. The decantation method, as outlined above in the centrifugal method, was found to possess marked advantages over the usual method of pipetting. Two extractions by the Roese-Gottlieb method did not remove all the fat, and a third extraction was made in every case. The following tabulation shows the increased amount of fat obtained by this third extraction in a series of determinations in both the sweetened and unsweetened milk.

In every case but one fat was obtained by third extraction, amounting to from 0.06 to 0.76 per cent.; the average increase was 0.19 per cent. For accurate work the third extraction is therefore necessary.

A comparison of the two fat methods, as shown by the results in the

Milk Taken. gms.	Fat Obtained. Two Extr. gm.	Fat Obtained. Three Extr. gm.	Per Cent. of Fat. Two Extr.	Per Cent. of Fat. Three Extr.
2.099	.1880	.1990	8.96	9.48
2.099	.1887	.1958	8.99	9.32
2.100	.1795	.1915	8.36	9.12
2.100	.1883	.1882	8.97	8.97
1.680	.1334	.1361	7.92	8.10
1.915	.1635	.1663	8.54	8.74
2.400	.1542	.1580	6.43	6.58
1.865	.1681	.1693	9.01	9.07
2.045	.1939	.1962	9.48	9.64
1.893	.1420	.1450	7.50	7.66
1.620	.1355	.1376	8.36	8.49
2.230	.1670	.1707	7.49	7.63
2.075	.1785	.1830	8.60	8.82
2.243	.1840	.1877	8.20	8.36
2.108	.2044	.2087	9.70	9.90
2.100	.1894	.1907	9.02	9.08
2.040	.1683	.1717	8.25	8.42
2.105	.1874	.1899	8.90	9.02
1.768	.1409	.1453	7.97	8.22
2.253	.1950	.1977	8.66	8.77
1.800	.1564	.1580	8.69	8.78
Ave.	.1717	.1755	8.48	8.67

table, indicates that on the average slightly higher results were obtained by the centrifugal method.

In twenty-five samples of sweetened milk higher results were secured in eighteen cases by the centrifugal method and in seven cases by the Gottlieb, the results by the former method being on the average 0.15 per cent. higher. In the unsweetened milk the results are even more favorable to the centrifugal method, nine of the ten samples showing higher fat by this method, with an average of 0.34 per cent. higher.

Comparison of Lactose Methods.

The official method for lactose requires boiling for six minutes with the copper reagent. It has been claimed that this comparatively long period of boiling might cause high results, the sucrose appearing to throw down some copper. All the samples were tested by the official method as well as by a method which involved boiling for two minutes. In twenty-six samples of sweetened milk the six minutes' boiling gave higher results in every case, ranging from 0.01 to 0.51, with an average of 0.30 per cent. In the unsweetened milk, as would be expected, the differences were less, one sample showing 0.03 per cent. less by the longer boiling; the other samples, however, gave higher figures by from 0.03 to 0.35, with an average of 0.14 per cent.

TABLE XI. COMPARATIVE FAT AND LACTOSE DETERMINATIONS.

Sweetened Milk.

Fat.			Lactose.		
Babcock-Leach.	Roese-Gottlieb.	Difference.	2 min.	6 min.	Difference.
9.95	9.37	−0.58	12.25	12.58	+0.33
9.22	8.95	−0.27	11.80	12.11	+0.31
9.26	9.12	−0.14	13.57	13.83	+0.26
9.61	9.83	+0.32	11.56	11.87	+0.31
8.94	8.81	−0.13	11.45	11.63	+0.18
9.30	9.05	−0.25	20.11	20.34	+0.23
10.04	9.45	−0.59	12.61	12.88	+0.27
8.18	7.75	−0.43	12.20	12.53	+0.33
8.89	8.58	−0.31	12.82	13.24	+0.42
9.63	9.67	+0.04	12.92	13.43	+0.51
10.06	10.29	+0.23	13.69	14.14	+0.45
8.85	8.81	−0.04	18.37	18.65	+0.28
9.58	8.92	−0.66	11.92	12.10	+0.18
9.43	9.12	−0.31	12.32	12.60	+0.28
9.18	8.50	−0.68	13.97	14.32	+0.35
7.75	8.24	+0.49	16.36	16.68	+0.32
----	----	----	12.30	12.78	+0.48
9.57	9.85	+0.28	15.23	15.44	+0.21
9.29	9.54	+0.25	14.73	15.06	+0.33
8.99	8.87	−0.12	12.57	12.99	+0.42
9.09	9.29	+0.20	11.88	12.22	+0.34
9.88	9.80	+0.08	11.18	11.54	+0.36
8.84	8.81	−0.03	22.82	22.83	+0.01
9.40	8.93	−0.47	12.28	12.37	+0.09
9.86	9.62	−0.24	13.65	13.92	+0.27
Ave. **9.28**	**9.13**	**−0.15**	**13.78**	**14.08**	**+0.30**

TABLE XII.—COMPARATIVE FAT AND LACTOSE DETERMINATIONS.

Unsweetened Milk.

Fat.			Lactose.		
Babcock-Leach.	Roese-Gottlieb.	Difference.	2 min.	6 min.	Difference.
8.73	7.99	−0.74	10.49	10.84	+0.35
8.96	8.40	−0.56	10.66	10.76	+0.10
----	----	-- --	10.75	11.00	+0.25
10.20	10.08	−0.12	----	----	-----
7.88	7.97	+0.09	----	----	-----
8.62	8.56	−0.06	----	----	-----
8.57	8.18	−0.39	10.67	10.87	+0.20
7.20	6.53	−0.67	9.76	9.91	+0.15
7.75	7.26	−0.49	8.62	8.59	−0.03
9.11	9.09	−0.02	11.24	11.24	+0.03
8.83	8.42	−0.41	10.88	10.94	+0.06
Ave. **8.59**	**8.25**	**−0.34**	**10.38**	**10.52**	**+0.14**

GELATIN.

The standard for gelatin is as follows:

"*Gelatin* (*edible gelatin*) is the purified, dried, inodorous product of the hydrolysis, by treatment with boiling water, of certain tissues, as skin, ligaments, and bones, from sound animals, and contains not more than two (2) per cent. of ash and not less than fifteen (15) per cent. of nitrogen."

Gelatin is derived from collagen, the chief constituent of connective tissue. By proper treatment any form of connective tissue can be made to yield gelatin. Hide clippings yield glue, a crude form of gelatin, and much commercial gelatin is simply a purified glue, derived from such a source. Isinglass, obtained from the swimming bladder of the sturgeon and other fish, is the purest form of gelatin. The gelatin obtained from calves' feet, free from bone, is also of high quality.

Gelatin is very soluble in boiling water, and on cooling sets into a jelly. This jellying will occur in a solution containing as little as 1 per cent. of gelatin.

Gelatin is very easily digested in the stomach. However, it is not capable of building tissues, and cannot be considered as a satisfactory substitute for proteins. Its chief value in feeding is as a protein sparer, "being able to save from destruction half its weight of proteid, or twice as much as is spared by an equal quantity of carbohydrate."* It must be remembered, however, that in the usual animal diet not more than one-eighth of the total nitrogen is in the form of gelatin, and that "probably not more than 25 to 30 grammes (about 1 ounce) of the latter substance can conveniently be taken in a day."† A large helping (6 ounces) of calf's foot jelly contains less than one-half ounce of gelatin, the remainder being largely sugar and water. In convalescence jellies are of service as a pleasant supplement to the ordinary diet, but the actual nutriment they supply from the gelatin itself is relatively small.

The cost of gelatin naturally depends upon the source from which it is derived, that from calves' feet being much more expensive than the usual commercial gelatin, and that from isinglass being even more costly. Ordinary chemical analysis reveals

* Hutchinson, "Food and the Principles of Dietetics," 1906, p. 77.
† *Loc. cit.*

Table XIII.—Analyses of Gelatin.

Station No.	Brand.	Dealer.	Net Weight of Package.	Price of Package.	Cost per oz. of Material.	Water.	Ash.	Gelatin (Nx5.55).	Undetermined.	Form of Nitrogen. Total.	Ppt. by Zinc Sulphate.	Insoluble & Coagulable.
			oz.	cts.	cts.							
22073	*Refined Sparkling Gelatine. S. S. Adams, New Haven	*New Haven:* S. S. Adams	1.06	8	7.5	13.90	1.98	83.58	0.54	15.06	15.00	Tr.
22192	Calves' Foot Gelatine. The Baker Co., New York and Shell, Va.	*Danielson:* Waldo Bros.	1.31	10	7.6	12.26	1.70	84.25	1.79	15.18	15.12	Tr.
22055	*Transparent Gelatine. James Chalmers Sons, Williamsville, N. Y.	*New Britain:* John Clauson	1.90	15	7.9	14.18	1.75	84.80	+0.73	15.28	14.88	Tr.
22074	Peter Cooper's Clarified Gelatine	*New Haven:* The Mohican Co.	2.19	10	4.6	13.30	2.55	83.03	1.12	14.96	14.96	Tr.
22103	Instant Powdered Gelatine. J. & G. Cox, Edinburgh, Scotland	*New Haven:* F. J. Markle Co.	1.55	15	9.7	13.81	1.80	84.36	0.03	15.20	15.20	Tr.
22036	Crystal Gelatine. Crystal Gelatine Co., Boston	*New Haven:* Weiss Bros.	1.02	10	9.8	12.09	1.18	85.36	1.37	15.38	15.32	....
22076	Grandmother's A. & P. Gelatine. The Great Atl. & Pac. Tea Co., New York	*New Haven:* Atlantic & Pacific Tea Co.	2.05	5	2.4	12.63	1.95	84.58	0.84	15.24	14.08	Tr.
22111	*Flag Brand Calves' Foot Gelatine. Keefe & Davis	*New London:* F. H. Davis & Co.	0.95	10	10.5	12.05	3.20	83.69	1.06	15.08	15.10	....
22056	*No. 1 Sparkling Calves' Head Gelatine. C. B. Knox, Johnstown, N. Y.	*New Britain:* Andresen & Elmgren	1.16	15	12.9	13.75	1.77	84.69	+0.21	15.26	14.40	Tr.
22186	Keystone Silver White Gelatine. Michigan Carbon Works, Detroit	*Norwich:* J. P. Holloway	1.73	10	5.8	12.35	2.50	84.25	0.90	15.18	15.12	Tr.
22049	*Minute Plain Gelatine. Minute Tapioca Co., Orange, Mass.	*New Haven:* Weiss Bros.	1.76	10	5.7	10.05	0.80	72.83	†16.32	13.12	13.00	Tr.
22112	White Rose Brand Gelatine. Seeman Bros., New York	*New London:* Burr Bros.	1.31	10	7.6	14.50	2.23	82.97	0.30	14.95	15.00	....
22078	*Star Brand Calves Foot Gelatine. Star Gelatine Co., New York	*New Haven:* D. M. Welch & Son	0.99	5	5.1	14.70	1.40	83.14	0.76	14.98	14.80	Tr.
22212	*Sparkling Gelatine. Swampscott Gelatine Co., Boston	*Willimantic:* Willimantic Cash Store	1.09	10	9.2	13.15	1.60	83.69	1.56	15.08	15.12	....
22233	*Granulated Gelatine. W. W. Walker Co., Hartford	*Hartford:* Boston Branch Grocery	1.41	10	7.1	11.06	1.35	87.02	0.57	15.68	15.60	....
22054	*Sparkling Gelatine, Ground. The Williams & Carleton Co., Hartford	*New Britain:* John Clauson	1.34	10	7.5	13.41	1.12	85.14	0.33	15.34	14.84	Tr.

* Contains separate package of color, shown to be in each case a coal tar color.

† Largely sugar.

little as to the source of the gelatin, and in this examination no attempt has been made to solve that problem. A high ash would indicate an imperfect method of manufacture, and a low nitrogen content an impure article, but neither of these determinations affords definite information as to the quality of the gelatin.

Sixteen samples of commercial gelatin were analyzed. All but one, No. 22049, satisfied the standard's requirements for nitrogen (this sample contained a large quantity of sugar); four exceeded the maximum allowed by the standard for ash, Nos. 22074, 22111, 22186, and 22112. In most samples practically all of the nitrogen was precipitated by zinc sulphate, but in Nos. 22076 and 22056 appreciable quantities of nitrogen were unaffected by this reagent, showing the presence of nitrogenous matter other than gelatin. Not more than traces of insoluble and coagulable nitrogen were found in any sample.

Nine of the sixteen samples were accompanied by a separate package of coloring matter to be used in preparation of the jelly. *In every case this was a coal-tar color, giving the reaction* of a Bordeaux. The gelatins themselves ranged from almost pure white to yellowish-gray in color.

Only two samples were guaranteed as to weight, Nos. 22111 and 22078, in both of which two ounces were claimed; the net weight of both samples was a trifle less than one ounce.

The net weight of all the samples varied between about one and two ounces, with a cost of from 5 to 15 cents per package, the gelatin costing from 2.4 to 12.9 cents per ounce, a very wide range in price.

To summarize, six samples did not satisfy the established standard, or were short weight, viz.:

22049. *Minute Plain Gelatin* (low nitrogen).

22074. *Peter Cooper's Clarified Gelatine* (high ash).

22186. *Keystone Silver White Gelatine* (high ash).

22112. *White Rose Brand Gelatine* (high ash).

22111. *Flag Brand Calves' Foot Gelatine* (high ash and short weight).

22078. *Star Brand Calves' Foot Gelatine* (short weight).

GRAPE JUICE.

The standard for grape juice is as follows:

"*Grape juice, grape must,* is the fresh fruit juice obtained from grapes (*Vitis* species), has a specific gravity (20° C.) not less than 1.0400 and not exceeding 1.1240; and contains in one hundred (100) cubic centimeters (20° C.) not less than seven (7) grams nor more than twenty-eight (28) grams of total sugars, in terms of reducing sugars, not less than twenty (20) centigrams and not more than fifty-five (55) centigrams of grape ash, and not less than fifteen (15) milligrams nor more than seventy (70) milligrams of phosphoric acid (P_2O_5)."

Nine samples were examined; six of these purported to be pure grape juice, two admitted the addition of cane sugar, and one was carbonated.

The specific gravity in all cases lay within the limits of the standard; the total sugars likewise satisfied the standard, ranging from 11.0 to 20.6 per cent. Cane sugar as such was present in traces only, but this by no means indicates that it was not used. For instance, in **21308**, where not over 5 per cent. of cane sugar was claimed to have been added, the analysis showed but 0.5 per cent.; this was undoubtedly due to the inversion of the cane sugar by the juice's acidity.

McGill* suggests that "it is highly probable that wherever the dry solids much exceed 15 per cent., sugar has been added to the grape juice." Such is the case in three of our samples, in two of which the use of sugar is declared on the label. The high percentage of solids in the third sample, **21010**, 26.22, points strongly to the addition of sugar.

Unmistakable traces of alcohol were found, ranging from 0.17 to 0.68 per cent. by volume. The acidity, calculated as tartaric, ranged from 0.28 to 1.27 per cent. The low acidity of **21050** is somewhat suspicious, but may possibly be due to a loss of volatile acids during the removal of the carbonic acid which was present in this sample.

No foreign coloring matter was found in any of the samples, nor was salicylic acid, benzoic acid or saccharin detected in any case.

* Canada Int. Rev. Dept., Bull. 166, 6.

Table XIV.—Analyses of Grape Juice.

Station Number.	Brand.	Dealer.	Price per Bottle.	Specific Gravity at 15.6° C.	Alcohol by Volume.	Solids.	Acids other than Carbonic as Tartaric.	Cane Sugar	Invert Sugar.	Polarization. Direct.	Polarization. After Inversion	Polarization. Temperature.	Color.	*Preservatives.
			Cts.									°		
21050	Randall's Carbo-Grapo. Chatauqua Fruit Co., Ripley, N. Y.	*Meriden:* Boston Grocery Co.	12	1.0580	0.40	14.50	0.28	0.0	11.0	−3.2	−3.2	24	Natural.	None.
21247	Gleason's Grape Juice. The Gleason Grape Juice Co., Fredonia, N. Y.	*Norwich:* Grover and Herrick	25	1.0670	0.54	16.31	0.91	0.0	13.7	−4.0	−4.0	24	Natural.	None.
21017	A. & P. Grape Juice. The Great Atlantic and Pacific Tea Co., New York	*Stamford:* Atlantic & Pacific Tea Co.	10	1.0600	0.50	14.80	0.71	0.0	17.9	−5.2	−5.2	24	Natural.	None.
21038	[1]Naboth Brand. The Naboth Vineyards, Brocton, N. Y.	*Norwalk:* Broggiano's Confec'nery	15	1.0876	0.67	20.85	1.17	0.5	12.1	−4.0	−4.6	24	Natural.	None.
21268	Paw Paw Grape Juice. Paw Paw Grape Juice Co., Paw Paw, Mich.	*Hartford:* Wise, Smith & Co.	10	1.0674	0.68	16.14	0.74	0.3	12.7	−4.0	−4.4	24	Natural.	None.
21010	Randall's Gold Medal Brand. The Randall Grape Juice Co., Ripley, N. Y.	*Stamford:* Olympia Candy Co.	10	1.1062	0.40	26.22	1.03	0.7	15.1	−5.1	−6.0	24	Natural.	None.
20975	Schühle's Pure Grape Juice. John Schühle. Distributed by Apothecaries Hall, Waterbury.	*Waterbury:* Brass City Drug Co.	25	1.0577	0.17	13.21	0.82	0.0	15.8	−4.6	−4.6	24	Natural.	None.
21045	[2]Vineland Grape Juice. The Vineland Grape Juice Co., Vineland, N. J.	*Meriden:* H. E. Bushnell.	15	1.0843	0.58	20.49	0.96	0.3	12.7	−4.0	−4.4	24	Natural.	None.
21032	Welch's Grape Juice. The Welch Grape Juice Co., Westfield, N. Y.	*Stamford:* Marron's Pharmacy.	15	1.0617	0.37	14.93	1.27	0.0	20.6	−6.0	−6.0	24	Natural.	None.

[1]Guaranteed to contain granulated sugar not over 5 per cent.
[2]Guaranteed small per cent. of cane sugar added.

* Salicylic acid, benzoic acid, saccharin.

JELLY POWDERS.

These preparations are widely used as quick desserts. They consist chiefly of cane sugar, with sufficient gelatin to make a jelly, and are variously flavored and colored to simulate the flavor and color of natural fruits. As a rule their compound nature is more or less clearly indicated on the label.

Of the twelve samples examined, all but three were stated on the label to be artificially colored. The color of *Bromangelon* was claimed to be "pure vegetable coloring." It was instead from cochineal, an insect.

It should be clearly understood that certain so-called fruit extracts, like banana, pineapple, strawberry and raspberry, are usually synthetic, and, therefore, the consumer, in using jelly powders and similarly flavored materials, bearing the names of these flavors, should not be misled into believing that the genuine fruit flavor is being supplied in all cases.

As shown on another page, the average analysis of fifteen commercial gelatins sold in this State was 13.14 per cent. water, 1.87 per cent. ash, and 84.30 per cent gelatin. The jelly powders, reported in Table XV, on the average contained 1.63 per cent. water, 0.27 per cent. ash, 8.52 per cent. gelatin and 88.95 per cent. cane sugar, the three substances first named being almost entirely derived from the commercial gelatin used. It is evident, therefore, that these jelly powders on the average consist of about one part of commercial gelatin and nine parts of cane sugar. For this sugar the buyer pays on the average about 22 cents per pound.

OTHER DESSERT PREPARATIONS.

Four miscellaneous dessert preparations were also examined. The descriptions follow:

22030. *Imperial Wine Jelly, Sherry,* artificially colored with vegetable color. Made by E. C. Rich, New York. Sold by Geo. Chitty, New Haven. Cost, 10 cents per package of 8.4 ounces.

22034. *Lipton's Delicious Gelatin Jelly Tablet,* Artificially Colored Compound, Strawberry Flavor. Made by Thomas Lipton, New York. Sold by The Mohican Co., New Haven. Cost, 10 cents per package of 5.8 ounces.

Station No.	Brand.	Dealer.	Net Weight of Package.	Price per package.	Cost per ounce of material.	Water.	Ash.	Gelatin (N x 5.55).	Sucrose.	Undetermined.	Form of Nitrogen. Total.	Form of Nitrogen. Precipitated by Zinc Sulphate	Color.
			oz.	cts.	cts.								
22032	Burnham's Jellycon, Lemon. E. S. Burnham Co., New York	*New Haven:* The Mohican Co.	4.3	9	2.1	1.46	0.17	8.33	90.08	+0.04	1.50	1.46	*
22075	D-Zerta, Raspberry. D-Zerta Food Co., Rochester, N. Y.	*New Haven:* H. Hahn	4.3	10	2.3	2.55	0.30	11.99	85.36	+0.20	2.16	2.12	Artificial.
22033	Jello-O, Raspberry, The Genesee Pure Food Co., LeRoy, N. Y.	*New Haven:* The Mohican Co.	3.5	9	2.5	1.95	0.30	12.43	86.40	+1.08	2.24	2.20	*Artificial.
22027	Grandmother's A. & P. Jelly Powder, Strawberry. The Great Atlantic & Pacific Tea Co., New York	*New Haven:* Atl. & Pac. Tea Co.	3.9	10	2.6	1.17	0.25	7.22	90.99	0.37	1.30	1.28	*Coal-tar.
22063	Gelvet, Lemon. Michigan Carbon Works, Detroit, Mich.	*New Britain:* Murphy's Grocery	4.4	10	2.3	2.16	0.20	7.77	88.45	1.42	1.40	1.36	Natural.
22031	Mohican Brand Jelly Powder, Orange. The Mohican Co.	*New Haven:* The Mohican Co.	5.3	8	1.5	1.25	0.18	6.22	92.57	+0.22	1.12	1.08	*Coal-tar.
22035	Plymouth Rock Coffee Jelly. Plymouth Rock Gelatine Co., Boston	*New Haven:* John P. Hugo	1.9	25	12.9	2.00	0.90	13.54	80.81	2.75	2.44	2.40	Caramel.
22202	Hoople's Strawberry Jelly. Raines & Co., New York	*Putnam:* W. H. Mansfield & Co.	4.6	10	2.2	1.97	0.35	9.44	84.97	3.27	1.70	1.68	*Coal-tar.
22028	Tryphosa, Raspberry. E. C. Rich, New York	*New Haven:* Geo. Chitty	6.9	10	1.4	1.14	0.13	5.77	92.80	0.16	1.04	1.04	*Coal-tar.
22029	Tryphosa, Strawberry. E. C. Rich, New York	*New Haven:* Geo. Chitty	6.9	10	1.4	0.92	0.20	5.55	92.87	0.46	1.00	1.00	*Coal-tar.
22113	White Rose Brand Jelly Powder, Raspberry. Seeman Bros., N. Y.	*New London:* Burr Bros.	5.3	10	1.9	1.57	0.10	6.22	91.44	0.67	1.12	1.08	*Coal-tar.
22064	Bromangelon, Strawberry. The Stern & Saalberg Co., N. Y.	*New Britain:* Sovereign Trading Co.	4.5	10	2.2	1.40	0.20	7.77	90.63	0.00	1.40	1.40	*Cochineal.

* Artificial color declared on the label.

22184. *Our-Pie Preparation,* for making lemon flavored pies, substitute color. "Made from cereal, vegetable and fruit products. Does not contain gelatine." Made by D-Zerta Food Co., Rochester, N. Y. Sold by J. P. Holloway, Norwich. Cost, 10 cents per package of 6.2 ounces.

22185. *Fruit Puddine, Flavored Rose Vanilla.* Made by Fruit Puddine Co., Baltimore, Md. Sold by Joseph Connor & Sons, Norwich. Cost, 10 cents per package of 8 ounces.

The analyses of these materials follow:

	22030	22034	22184	22185
Water	15.77	15.80	5.24	10.25
Ash	0.33	0.10	2.16	1.60
Gelatin (N × 5.55)	9.16	9.88	....	....
Protein (N × 6.25)	....	....	2.25	0.31
Sucrose (sugar)	63.22	71.35	47.45	Present
Starch	....	....	43.04	81.34
Undetermined	11.52	2.87	....	6.50
Total Nitrogen	1.65	1.78	0.36	0.05
Nitrogen ppt. by zinc sulphate	1.60	1.72	....	....
Color	Caramel	Artificial	Natural	Artificial

LARD.

One hundred and four samples of lard were examined, of which ninety-seven were not found to be adulterated, while seven were compound lard sold as "lard," and therefore must be classed as adulterated. The adulterated samples in every case

TABLE XVI.—ANALYSES OF ADULTERATED LARD.

Station No.	Dealer.	Price per pound cents.	Refractive Index at 40° C.	Halphen Test	Belfield Test.
21863	*Bridgeport:* Public Market	10	1.4633	Deep red	Beef stearin
21865	*Bridgeport:* Centennial Tea Co.	10	1.4633	Deep red	Beef stearin
220[illegible]8	*New Britain:* Murphy's Grocery	10	1.4633	Deep red	Beef stearin
2217[illegible]	*New London:* A. Gordon	10	1.4629	Deep red	Beef stearin
21942	*Stamford:* Empire State Tea Co.	10	1.4626	Deep red	Beef stearin
21881	*Waterbury:* F. I. Fabricant	10	1.4626	Deep red	Beef stearin
21879	*Waterbury:* J. P. McCarthy	12	1.4633	Light red	Beef stearin

were shown to consist largely of cotton seed oil with a certain percentage of beef stearin.

The sale of compound lard for lard is a fraud akin to the sale of oleomargarine for butter. Even if the product is designed

merely as a substitute for lard and is sold at wholesale under its true name, when retailed as "lard" it is morally, as well as legally, an adulterated food product.

The analyses of the adulterated samples are given in Table XVI.

Lard has been examined a number of times by this station; a summary of these examinations is given in the following tabulation:

	Not found Adulterated.	Adulterated.	Per cent. Adulterated.
1896	75	43	36.4
1900	150	10	6.3
1902	111	55	33.1
1903	67	63	48.5
1905	47	24	33.8
1906	81	34	29.6
1907	86	20	18.9
1908	107	7	6.1

In the samples examined this year the physical constants varied as follows:

	Refractometer Reading at 40°.	Refractive Index at 40°.
Lard not found adulterated	49.5–51	1.4590–1.4600
Adulterated lard	55 –56	1.4626–1.4633

LEMON EXTRACT.

The standard for lemon extract is as follows:

"*Lemon extract* is the flavoring extract prepared from oil of lemon, or from lemon peel, or both, and contains not less than five (5) per cent. by volume of oil of lemon."

Since the alcohol in a good extract costs about four times as much as all the other constituents together, certain manufacturers reduce this cost by substituting dilute alcohol, or in rare cases, even wood alcohol. Lemon oil, however, is practically insoluble in dilute alcohol, hence by reducing the strength of the alcohol the manufacturer cuts out the lemon oil almost entirely, and renders the extract almost worthless for flavoring purposes. Many of the brands on the market contain so little lemon oil that it can hardly be detected either by chemical analysis or by the nostrils. They are commonly made either by shaking lemon

oil with weak alcohol and removing the excess of oil, or by dissolving a little "citral" or other substitute in dilute alcohol, thus securing the so-called "terpeneless" lemon extracts. These extracts are often colored with turmeric tincture or, more commonly, with a coal-tar dye. An ounce of such an extract selling for 10 cents contains material costing but a fraction of a cent, and very inferior as a flavor.

Fifty-five samples of lemon extract, representing forty brands, have been examined this year. Twenty-two of these were not found to be adulterated, fifteen were adulterated in one or more particulars, and eighteen were labeled compound or imitation.

The pure extracts ranged from 5.13 to 10.75 per cent. of lemon oil by volume and from 77.75 to 90.78 per cent. of alcohol by volume.

Of the adulterated extracts, one contained glycerol, two were low in lemon oil, six were both low in lemon oil and artificially colored, and six were artificially colored. The percentage of lemon oil ranged from none at all to 10.66, the alcohol from 24.31 to 85.47 per cent. Three samples which contained unusually large quantities of lemon oil were artificially colored. No. **21401**, *Foss's Extract,* showed artificial color in one bottle and not in another purchased from the same dealer at the same time. The labeling of the cartons showed that they represented different shipments, and the adulterated sample was undoubtedly of old stock. The two samples of *Arthur's Extract* and the two of *Boston Lemon Flavoring* represented two distinct varieties of these brands. Certain other samples showed wide variations in the labeling of the bottle and carton; this will be referred to in more detail in connection with the compound extracts.

Of the eighteen compound or imitation extracts only one was legally labeled.

The law requires that the compound nature of any food product must be clearly stated on the label. A compound substance must not be named from one of its ingredients, nor must the label bear any misleading information. For instance, a solution of citral and coloring matter should not be labeled either "lemon flavor" or "extract of lemon" or "compound extract of lemon," but "imitation lemon extract" or "artificial lemon extract," or "extract of citral." If the preparation contained some genuine oil of lemon with the citral it should not be

labeled "compound lemon extract," but "compound lemon and citral extract" or "compound citral and lemon extract," according to which principle preponderates. Artificial colors should be declared on the label whenever present. The label of the carton and that of the bottle should be identical in all essential particulars.

Below is shown the nature of the illegality of the labels of the individual extracts:

20938. Label illegal, as it contained only a trace of lemon oil and "citral" is not included in the brand name.

21403. Same objections as against **20938.**

21058. Bottle and carton labeled differently, the latter, which the buyer sees, illegally, "citral" not being included in the brand name.

21107. Contains *over 39 per cent. of wood alcohol,* which is illegal in any food product. Contains only a trace of lemon oil and therefore should not he labeled "Compound Lemon." It is also artificially colored, which is not declared on the label.

21172. Bottle labeled "Dil. Lemon .40%," etc.; carton labeled "Oil Lemon .40%," etc. It contains only .09 per cent. lemon oil.

22174. It contains no lemon oil and therefore is illegally labeled "Compound Lemon Extract." It is guaranteed to contain .15.76 oil lemon. This guarantee is false and the two decimal points render it very misleading.

21106 and **21297.** They are illegally labeled "Compound Extract Lemon," as they contain no lemon oil. Their artificial color is not declared on the label and the following statement is false and misleading: "These extracts are of great strength. They are known to all who have used them as the Best."

21636a. It is illegally labeled "Extract of Compound Lemon," as it contains no lemon oil.

21636b. Labeled the same as **21636a,** and bought at the same time and place. It is below standard in lemon oil and no other ingredient is stated in the brand name.

21194. Guaranteed to contain 8 parts of best oil of lemon in 138 parts. It contains only a trace, and contains 5.46 per cent. of sugar, not declared in the formula. Carton and bottle labeled differently.

TABLE XVII.—LEMON EXTRACT NOT FOUND ADULTERATED.

Station No.	Brand.	Station No.	Price per Bottle, cts.	Capacity of Bottle, fl. oz.	Specific Gravity at 15.6° C.	Alcohol by Volume.	Lemon Oil by Volume. Polariscope Method.	Lemon Oil by Volume. Mitchell's Precipitat'n Method.	Refractive Index of Precipitated Oil at 30° C.	Color.
21193	Andresen's Pure Extract Lemon. C. Andresen, New York.	21193	20	2.2	.8364	87.77	5.13	5.00	1.4704	Natural
21239	Republic Lemon Extract. Austin, Nichols & Co., New York.	21239	10	1.5	.8253	90.25	5.94	5.90	1.4704	Natural
21773	Republic Lemon Extract. Austin, Nichols & Co., New York.	21773	18	1.9	.8508	81.25	5.19	5.30	1.4691	Natural
21368	Highly Conc. Flavoring Extract Lemon. The W'm Boardman & Sons Co., Hartford.	21368	20	1.9	.8422	80.46	5.63	5.90	1.4685	Natural
21217	Burnett's Superior Extract of Lemon. Joseph Burnett Co., Boston.	21217	20	1.9	.8206	88.42	10.75	10.60	1.4704	Natural
21644	Superior Flavoring Extract Lemon. W. D. & F. A. Casey, Willimantic.	21644	20	2.1	*	*	5.38	5.30	1.4691	Natural
21092	Supreme Conc. Extract Lemon. W. D. & F. A. Casey, Willimantic.	21092	10	0.9	*	*	6.56	6.20	1.4678	Natural
21216	Clover Brand Pure Flavoring Extracts Lemon.	21216	15	1.8	.8635	77.75	5.78	5.60	1.4704	Natural
21245	Mayflower Extract of Pure Lemon. The A. Colburn Co., Philadelphia.	21245	25	2.8	.8326	86.26	5.00	5.20	1.4704	Natural
21399	Health Brand Pure Lemon. Lewis DeGroff & Son, New York.	21399	25	1.7	.8473	80.49	6.08	6.10	1.4691	Natural
21397	Imperial Pure Fruit Flavoring Extracts Lemon. Springfield, Mass.	21397	8	1.2	.8407	83.68	5.06	5.20	1.4688	Natural
21303	Premium Lemon Flavor. McMonagle & Rogers, Middletown, N. Y.	21303	25	2.2	.8196	90.78	6.88	6.80	1.4685	Natural
21376	Mohican Pure Extract of Lemon. The Mohican Co., New York.	21376	25	4.0	*	*	4.41	5.50	1.4697	Natural
21673	Mohican Pure Extract of Lemon. The Mohican Co., New York.	21673	25	4.2	.8599	79.18	4.50	5.40	1.4700	Natural
21781	Pure Extract Lemon. The T. R. Sadd Co., Willimantic.	21781	20	2.2	.8275	87.34	5.13	5.20	1.4688	Natural
21013	Pure Concentrated Extract Lemon. The C. F. Sauer Co., Richmond, Va.	21013	10	0.9	*	*	5.81	5.80	1.4681	Natural
21672	Pure Concentrated Extract Lemon. The C. F. Sauer Co., Richmond, Va.	21672	10	1.0	.8570	79.70	6.22	6.50	1.4675	Natural
21401b	Foss' Pure Extract of Lemon. Schlotterbeck & Foss Co., Portland, Maine.	21401b	20	1.9	*	*	9.41	9.30	1.4688	Natural
21671	Foss' Pure Extract of Lemon. Schlotterbeck & Foss Co., Portland, Maine.	21671	25	1.9	.8353	79.83	9.56	9.40	1.4681	Natural
21108	Williams' Pure Extract of Lemon. The Williams & Carleton Co., Hartford.	21108	25	1.9	*	*	6.09	6.00	1.4685	Natural
21351	Williams' Pure Extract of Lemon. The Williams & Carleton Co., Hartford.	21351	20	1.9	.8332	84.63	5.97	5.90	1.4691	Natural
20968	Pure Flavoring Extracts, Lemon. Worth Extract Co., New York.	20968	10	0.9	.8523	81.42	5.19	5.20	1.4681	Natural

* Sample exhausted.

TABLE XVIII.—ADULTERATED LEMON EXTRACTS.

Station No.	Brand.	Station No.	Price per Bottle, cts.	Capacity of Bottle, fl. oz.	Specific Gravity at 15.6° C.	Alcohol by Volume.	Lemon Oil by Volume. Polariscope Method.	Lemon Oil by Volume. Mitchell's Precipitation Method.	Refractive Index of Precipitated Oil at 30° C.	Color.
21637	Arthur's Extract Pure Lemon. 5c and 10c Drug Cabinet Co., New Haven.	21637	10	1.4	.9421	44.42	0.10	Trace		Natural
21646	Arthur's Extract Pure Lemon. 5c. and 10c. Drug Cabinet Co., New Haven.	21646	10	1.4	.8898	67.67	1.90	2.10	1.4694	
21633	Atwood's Better Stronger Lemon. New Haven Extract Co., New Haven.	21633	10	1.1	*	*	4.33	4.30	1.4691	Turmeric
21402	[1] Crawford's Fine Flavors, Lemon. W. M. Crawford, Stafford Springs.	21402	25	1.9	.8740	81.91	4.93	5.10	1.4688	Natural
21160	[2] Premium Brand Extract of Lemon. East India Tea Co., Bridgeport.	21160	15	1.6	.9730	24.31	0.00	0.00		Turmeric
21218	Harris' Pure Extract Lemon. Frank E. Harris, Binghamton, N. Y.	21218	20	2.2	.8446	83.08	4.31	4.40	1.4685	Artificial
20969	[3] Climax Brand Highly Conc. Extract of Lemon. The Hub Grocery Co.	20969	10	1.6	.9670	33.83	0.00	0.00		Natural
21339	Extract Lemon. Lawlor & Dwyer, Ansonia.	21339	15	1.6	.8528	74.28	5.34	5.40	1.4678	Turmeric
21270	[4] Ideal Brand Extract Lemon. John H. McGuire, Hartford.	21270	20	1.6	.9487	41.49	0.00	0.00		Artificial
21051	[5] Boston Lemon Flavoring. Puritan Drug Co., Boston.	21051	10	1.5	.9618	33.83	Trace	0.00		Artificial
21257	[6] Boston Lemon Flavoring. Puritan Drug Co., Boston.	21257	10	1.4	.8998	62.08	1.09	1.30	1.4710	Artificial
21091	[7] Foss' Pure Extract Lemon. Schlotterbeck & Foss Co., Portland, Maine.	21091	20	1.9	.8445	85.47	9.59	9.20	1.4678	Artificial
21401a	[8] Foss' Pure Extract Lemon. Schlotterbeck & Foss Co., Portland, Maine.	21401a	20	2.0	*	*	9.75	9.60	1.4685	Artificial
21271	A Pure Concentrated Extract of Lemon. Union Extract Co., Buckland.	21271	25	1.9	.8346	79.85	10.66	10.20	1.4710	Artificial
21302	Ambassador Brand Extract of Lemon. James Van Dyk Co., New York.	21302	10	1.4	.8518	73.79	5.90	5.94	1.4685	Artificial

[1] Contains glycerol. [2] "Oil Lemon, Grain Alcohol and Harmless Coloring" on carton but not on bottle. [3] "Oil of Lemon, Grain Alcohol and Harmless Coloring" on carton but not on bottle. "The superiority of these extracts consists in their perfect purity and great strength.....being so highly concentrated a small quantity only need be used." [4] "⅜ Standard Strength, Formula by Volume: Oil Lemon 3%, Alcohol 50%, Water 50%, Artifically Colored" on both carton and bottle. [5] Labels on bottle and carton variable: on bottle "Made from Best Lemon Oil and Fresh Fruit, contains no *Citral* and no *Lemongrass*; *Oil Lemon (Sanderson's) 3%, Lemon Peel 2%, Cologne* Spirits 30%, Water to make 100%:" on carton "Prepared from Purest Materials; Oil Lemon (Sanderson's) 2.5%, Cologne Spirits 44%, Color q. s.," Water to make 100%." [6] Label on bottle and carton the same as on the bottle of No. 21051 except that "color q. s." is added. [7 8] No. 21091 consisted of two bottles labeled with the same wording but in slightly different type. The tops of the cartons were different; one read "Foss' Lemon," the other "This bottle contains two ounces, full measure." No. 21401 likewise consisted of two bottles, which were labeled alike except that (b) (see table XVII) bore a sticker around the neck with Serial No. The ends of the cartons were correspondingly different. * Sample exhausted.

TABLE XIX.—COMPOUND AND IMITATION LEMON EXTRACTS (ILLEGALLY LABELED).

Station No.	Brand.	Dealer.	Station No.	Price per bottle, cts.	Capacity of bottle, fluid ounce.	Specific gravity at 15.6° C.	Alcohol by volume.	Lemon Oil by Volume. Polariscope Method.	Lemon Oil by Volume. Mitchell's Precipitation Method.	Refractive Index of Precipitated Oil at 30° C.	Color.
20938	[1] O. K. Compound Lemon Flavoring. The C. L. Cotton P. & E. Co., Earlville, N. Y.	*Meriden:* Booth's Grocery	20938	10	1.7	*	*	0.13	0.00	....	Natural
21403	[2] O. K. Compound Lemon Flavoring. The C. L. Cotton P. & E. Co., Earlville, N. Y.	*Stafford Springs:* F. J. Chandler	21403	10	1.8	.9716	22.38	0.14	0.00	....	Natural
21058	[3] O. K. Imitation Lemon Flavoring. The C. L. Cotton P. & E. Co., Earlville, N. Y.	*Meriden:* Booth's Grocery	21058	10	1.9	*	*	0.10	0.00	....	Artificial
21107	Dingwall's Compound Lemon. M. C. Dingwall, New Haven	*New Haven:* M. C. Dingwall	21107	10	1.4	.9533	39.14[4]	0.11	0.00	....	Artificial
21172	[5] The Eureka Brand Imitation Flavor of Lemon. Hartford, Conn.	*Danbury:* M. McPhelemy Est.	21172	10	1.7	.9426	47.70	0.09	0.00	....	Natural
21774	[6] Royal Palm Compound Lemon Extract. Franklin Extract Co., New York	*Danielson:* A. H. Armington	21774	10	2.2	.9747	22.50	0.00	0.00	....	Artificial
21106	[7] Star Brand Compound Extract Lemon. Wm. J. Fuller & Son, New Haven	*New Haven:* D. M. Welch & Son	21106	10	1.2	.9784	24.12	0.00	0.00	....	Artificial
21297	[7] Star Brand Compound Extract Lemon. Wm. J. Fuller & Son, New Haven	*New Haven:* D. M. Welch & Son	21297	10	1.2	*	*	0.00	0.00	....	Artificial
21636 a	[8] Sterling Extract of Compound Lemon. J. H. Howland, Middletown, N. Y.	*New Haven:* J. Wagner	21636 a	10	1.4	*	*	0.00	0.00	...	Natural

* Sample exhausted.

[1] Labeled "Composed of Citral from Oil Lemon, Citral—Dilute Alcohol, Vegetable Color. Serial No. 370." On carton "grain" inserted before "alcohol." [2] Same as No. 20938. [3] Labeled "O. K. Imitation Lemon Flavoring Composed of Citral from Oil Lemon, Diluted Grain Alcohol, Vegetable Color." Carton labeled "O. K. Compound Lemon Flavoring. Colored. Composed of Oil Lemon, Terpeneless, Grain Alcohol, Water, Vegetable Color." [4] 95 per cent. of the alcohol is methyl (wood) alcohol. [5] Labeled "Artificially colored Dil. Lemon .40%, Citral .10%, Grain Alcohol dil. 99.50%." Carton labeled "Turmeric colored, Oil Lemon, .40%, Dil. Grain Alcohol 99.50%, Citral, 10%, Coloring, a trace." [6] Labeled "Oil Lemon, .15.76, Lemon color M 5, alcohol and water enough to make 100 parts." [7] Labeled "Prepared from Oil Lemon, Alcohol, Water, Artificial Color." Carton bore no formula, but these words: "These extracts are of great strength. They are known to all who have used them as the Best." [8] No formula given; the two bottles were of very unequal strength.

Station No.	Brand.	Dealer.	Station No.	Price per bottle, cts.	Capacity of bottle, fluid ounce.	Specific gravity at 15.6°C.	Alcohol by volume.	Lemon Oil by Volume. Polariscope Method.	Lemon Oil by Volume. Mitchell's Precipitation Method.	Refractive Index of Precipitated Oil at 30°C.	Color.
21636b	[8] Sterling Extract of Compound Lemon. J. H. Howland, Middletown, N. Y.	*New Haven:* J. Wagner	21636b	10	1.4	.8211	89.83	3.44	3.60	1.4685	Natural
21194	[9] Our Special Extract of Lemon, Compound. The McKee Medicine Co., Middletown	*Middletown:* O. Thompson & Co.	21194	10	1.6	*	*	0.40[10]	0.00	....	Artificial
21398	[11] Our Special Extract of Lemon, Com. The McKee Med. Co., Middletown	*Middletown:* O. Thompson & Co.	21398	10	1.4	.9592	46.11	0.00[12]	0.00	....	Artificial
21012	[13] Oakdale Flavoring Compound Lemon. Oakdale Packing Co., Philadelphia	*Stamford:* N. Y. Cash Grocery	21012	10	1.6	.9571	33.12	0.00	0.00	....	Natural
21340	[14] Sterling Brand Imitation Flavor of Lemon. Hartford, Conn.	*Ansonia:* Logan Bros. Co.	21340	15	1.9	.9373	40.19	0.10	0.00	....	Turmeric
21220	[15] St. John's Flavor of Lemon Compound. St. John & Co., New York	*New London:* F. H. Davis	21220	10	1.8	.9785	29.36	0.05	0.00	....	Artificial
21782	[15] St. John's Flavor of Lemon Compound. St. John & Co., New York	*New Britain:* D. M. Fickman	21782	10	1.6	.9944	32.08	0.00	0.00	....	Artificial
21195	[16] Supreme Concentrated Extract Lemon	*Middletown:* New England Tea Co.	21195	20	1.8	.9602	37.07	0.00	0.00	....	Artificial
	LEGALLY LABELED.										
21129	[17] P. C. Brand Imitation Lemon Flavor. Patterson-Cabell Co., Jersey City, N. J.	*Bridgeport:* L. Mooney	21129	10	1.0	.9670	27.99	0.19	0.00	....	Natural

[8] No formula given; the two bottles were of very unequal strength. [9] On the bottle "Pure" is indistinctly overstamped with "Compound." The carton bears this formula "Best Oil of Lemon, 8 parts, Glycerine, 2 parts, Proof Spirits, 128 parts, Lemon Color, a trace." [10] The polariscope reading indicated 5.88 per cent. of lemon oil; the extract contained 5.46 per cent. of sugar, giving the corrected value for lemon oil as reported. A second bottle of the same purchase gave 4.84 by the polariscope and 2.50 per cent. by the precipitation method. The sample being exhausted it was impossible to correct for the sugar. [11] Labeling the same as for No. 21194; formula on carton but not on bottle. [12] The polariscope reading indicated 5.79 per cent. of lemon oil; 4.97 per cent. of sugar was present, giving the corrected value for lemon oil as reported. [13] "Alcohol, Extract Lemon Peel, Oil Lemon, Water," on sticker on back of bottle and carton. [14] Bottle labeled "Turmeric colored, Oil Lemon, .40%, Water, 62.50%, Alcohol, 37.00%, Citral, .10%, Coloring, a trace." Carton labeled, the same except "Oil Lemon, 40%." [15] Bottle labeled as indicated in table. "Composed of 68.00 pure proof alcohol, 30.75 water, pure lemon oil and turmeric a trace, colored artificially." Carton labeled "Imitation Lemon Flavor" with same formula as on bottle. [16] No formula given on bottle

21398. Same guarantee as **21194**; contains no lemon oil, and 4.97 per cent. of sugar, not declared in the formula. Carton and bottle labeled differently.

21012. Illegally labeled "Compound Lemon," as it contains no lemon oil.

21340. Bottle labeled "Oil Lemon .40%," etc.; carton labeled "Oil Lemon 40%," etc. It contains only a trace of lemon oil.

21220 and **21782.** Bottles labeled "Compound," the cartons labeled "Imitation."

21195. Carton labeled "Lemon Compound, Sol. oil Lemon, 85 pts.," etc. The bottle label gave no indication of its compound nature. It contained no lemon oil.

In conducting our examination it was found that in several cases extracts from the same manufacturer, and labeled identically, varied greatly in composition, some containing no lemon oil and others several per cent.

Selling Prices.

While prices vary greatly, the *average* price of pure lemon extract per 2 ounces has been 18.4 cents, of the adulterated extracts 19.1 cents and of the compound extracts 13.5 cents.

Tables XVII, XVIII and XIX give the detailed analyses of the pure, adulterated and compound extracts respectively, the brand name used in all cases being that given on the bottle label.

MAPLE SYRUP.

The standard for syrup and maple syrup is:

"*Syrup* is the sound product made by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar."

"*Maple syrup* is syrup made by the evaporation of maple sap or by the solution of maple concrete, and contains not more than thirty-two (32) per cent. of water and not less than forty-five hundredths (0.45) per cent. of maple-syrup ash."

"*Sugar syrup* is the product made by dissolving sugar to the consistence of a syrup, and contains not more than thirty-five (35) per cent. of water."

Thirty samples were examined this year, of which eight were not found to be adulterated and twenty-two were labeled so as to indicate their compound nature.

TABLE XX.—ANALYSES OF MAPLE SYRUP NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per Bottle.	Total Solids.	Sucrose by Clerget.	Hortvet Number.	Lead Number (Winton).	Ash.
			cts.					
22270	Austin, Nichols & Co., New York. Sunbeam Brand	*New Haven:* The Mohican Co.	25	68.05	60.74	1.65	1.32	0.55
22189	Clark, Chapin & Bushnell, New York. Golden Crown Brand Pure Sap	*Norwich:* R. F. Smith	30	66.61	64.03	1.07	1.22	0.50
22080	The Great Atlantic & Pacific Tea Co., New York. A. & P. Pure	*New Haven:* Atl. & Pac. Tea Co.	15	65.55	58.74	1.69	1.69	0.58
22272	W. J. Lamb Co., West Somerville, Mass. Pure	*New Haven:* John Gilbert & Sons	30	65.10	57.35	1.32	1.62	0.49
22198	Francis H. Leggett & Co., New York. Premier Pure Sap	*Putnam:* E. T. Tucker	25	65.66	63.76	1.14	1.33	0.56
22279	Stoddard, Gilbert & Co., New Haven. Hermitage Brand	*Bridgeport:* Osborne Bros.	25	62.96	57.06	1.79	1.68	0.73
22271	The Vermont Maple Sugar & Syrup Co., New Haven. Pure	*New Haven:* Conrad Rausch	25	62.67	56.29	1.37	1.18	0.44
22234	Welch Bros. Maple Co., Burlington, Vt. Vermont's Finest Quality	*Hartford:* Boston Branch Grocery	30	68.37	62.85	1.34	1.28	0.58

Station No.	Brand.	Dealer.	Price per Bottle.	Total Solids.	Sucrose by Clerget.	Hortvet Number.	Lead Number (Winton)	Ash.
			cts.					
22224	†Austin, Nichols & Co., New York. Hudson Brand Syrup	*Rockville:* McNeill & Conway	10	66.54	62.56	0.08	0.09	0.06
22090	†Austin, Nichols & Co., New York. Republic Brand Syrup	*New Haven:* O. Nestle	15	65.16	58.43	0.16	0.83	0.13
22250	†Bay State Maple Syrup Co., Boston. Mt. Mansfield Brand Fancy Sugar Syrup	*Hartford:* F. L. Churchill	10	68.21	64.60	0.18	0.27	0.30
22081	‡Boyle & Williams, Bradford, Pa. Silver Seal Table Syrup	*New Haven:* The Mohican Co.	10	66.06	61.43	0.19	0.27	0.17
22276	†Falcon Packing Co., New York. Old Homestead Syrup	*Bridgeport:* Public Market	15	68.55	66.08	0.08	0.24	0.11
22260	†Fred Fear, New York. My Wife's Syrup	*Stamford:* E. P. Jordan	10	65.64	59.59	0.16	0.29	0.37
22246	†The R. M. Fitz Gerald Co., Hartford. Mascot Pure Syrup Fancy Quality	*Hartford:* Wm. Walker	10	67.06	63.27	0.23	0.34	0.29
22277	†Hallett Table Water Co., Bridgeport. Pure Cane and Maple Nonquit Syrup	*Bridgeport:* Centennial Tea Co.	15	65.92	58.73	0.16	0.92	0.75
22208	†Huntington Maple Syrup & Sugar So., E. Providence, R. I. Gold Leaf Syrup	*New Haven:* D. M. Welch & Son	10	66.92	66.57	0.11	0.13	0.09
22118	†Huntington Maple Syrup & Sugar Co., E. Providence, R. I. Gold Leaf Syrup	*New London:* Atl. & Pac. Tea Co.	10	67.46	64.08	0.05	0.22	0.09
22286	‡Huntington Maple Syrup & Sugar Co., E. Providence R. I. Home Brand Syrup	*Danbury:* M. McPhelemy Est.	25	65.57	59.75	0.14	0.36	0.04
22280	†W. J. Lamb Co., West Somerville, Mass. Gold Brand Syrup	*Bridgeport:* Public Market	15	63.30	59.55	0.14	1.22	0.14
22285	†Francis H. Legget & Co., New York. Nabob Pancake Syrup	*Danbury:* Robertson & Menzie	20	65.63	63.29	0.21	0.62	0.14
22091	†F. J. Markle, New Haven. Gold Medal Brand Fancy Syrup	*New Haven:* F. J. Markle	10	68.85	67.91	0.11	0.15	0.04
22278	†New England Maple Syrup Co., Boston. Golden Tree Syrup	*Bridgeport:* H. Isenberg & Co.	10	68.67	62.59	0.22	0.36	0.05
22082	†New England Maple Syrup Co., Boston. Golden Tree Syrup	*New Haven:* Kohn Bros.	25	70.44	65.27	0.34	0.63	0.55
22259	‡M. Schoenberg & Co., New York. White Label Table Syrup	*Stamford:* Cash Premium Store	10	65.86	51.02	0.17	0.17	0.18
22079	†Vermont Maple Syrup Co., New Haven. Favorite Brand Fancy Syrup	*New Haven:* E. Schoenberger & Sons	10	68.68	67.11	0.11	0.09	0.08
22264	†Vermont Maple Syrup Co., New Haven. Peerless Brand Fancy Syrup	*So. Norwalk:* Central Food Co.	15	68.28	67.61	0.04	0.28	0.04
22089	†Vermont Maple Sugar & Syrup Co., New Haven. Pride of the Farm Brand Fancy	*New Haven:* A. H. Waterbury	10	68.03	67.75	0.15	0.10	0.06
22117	†Vermont Maple Sugar & Syrup Co., New Haven. Pride of the Farm Brand Fancy	*New London:* Reddin's Cash Grocery	15	68.91	68.21	0.15	0.09	0.05
22265	‡Waltemade Bros. Co., New York. Colonial Brand Syrup	*So. Norwalk:* A. F. Beckman & Co.	15	68.30	66.49	0.12	0.24	0.18

* Stated on the labels to be mixtures

This station has made three earlier examinations of this product, and the results are tabulated below, together with those of this year, except for the year 1896, when many samples were doubtless passed as unadulterated because of the imperfect methods of analysis at that time available.

	1906.	1907.	1909.
Not found adulterated	3	7	8
Adulterated	17	5	..
Compound	19	11	22
Per cent. adulterated	43.6	21.7	0.0

There has been a marked improvement in the accuracy of the labeling, many brands previously classed as adulterated now being labeled "compound" or "blend." There is considerable room, however, for further improvement in the matter of labeling. The Federal government, and this station as well, has ruled that in compounds or blends the predominating ingredient must be named first in the label—for instance, "maple and cane sugar" or "cane and maple sugar." If this ruling were strictly enforced, four of the samples reported in Table XXI would be technically illegal, as they are stated to be blends of maple and cane sugar, whereas in fact the cane sugar largely predominates. Furthermore, in the great majority of the "compound" samples, maple syrup is present in only very small quantities, in some cases mere traces. The proper label for most of these samples would be "Sugar Syrup, Maple Flavor."

In only one of the compound syrups does the word "maple" appear in the brand name, **22277**, *Pure Cane and Maple Nonquit Syrup.* This sample had a strong brown-sugar taste, with no maple flavor whatever. Its low Hortvet number indicates the absence of any considerable amount of maple syrup, and its relatively high ash is due to brown sugar. **22082** is the only compound sample having a strong maple flavor; in the others it is very slight or entirely absent, as in **22260** and **22280**, which have a molasses-like and honey-like flavor respectively.

The standards for maple syrup refer only to the ash and water content. The samples classed as not adulterated all satisfy the ash standard, ranging from 0.44 to 0.73 per cent. Only two of the samples, however, satisfy the minimum requirement for total solids, 68 per cent. The others range from 62.67 to 66.61 per cent.

The total solids of the compound samples range from 63.30 to 70.44 and the ash from 0.04 to 0.75 per cent.

Methods of Analysis.

The methods used were those given in the Report of this station for 1906, pages 130 and 131. The range of value obtained for the Hortvet number, the Winton number and the ash is shown below:

	Not found Adulterated. Max.	Min.	Ave.	Compound. Max.	Min.	Ave.
Hortvet No.	1.79	1.14	1.42	0.34	0.05	0.15
Winton No.	1.69	1.18	1.42	1.22	0.09	0.36
Ash	0.73	0.44	0.55	0.75	0.04	0.18

OLIVE OIL.

All of the forty-four samples purchased by the station from groceries and delicatessen stores were found to be free from cottonseed, sesame and peanut oils. The specific gravity at 15.5° C. ranged from 0.915 to 0.917, and the refractive index at the same temperature from 1.4704 to 1.4713. The detailed analyses are given in Table XXII.

This is the sixth general examination made by this station of the olive oil sold in Connecticut. The following tabulation summarizes the results of the six inspections:

	Not found Adulterated.	Adulterated.	Per cent. Adulterated.
From grocers.			
1897	37	23	38.3
1900	45	28	38.4
1905	19	0	0.0
1906	25	0	0.0
1907	7	0	0.0
1908	44	0	0.0
From druggists.			
1897	13	5	27.8
1900	17	13	43.3
1905	21	9	30.0
1906	55	11	16.7
1907	65	11	14.5

The above tabulation shows the great improvement in the purity of this food product, especially as sold by grocers. Since 1905 no adulterated olive oil has been found in their stock.

TABLE XXII.—OLIVE OIL (CONTAINING NO COTTON SEED, SESAME OR PEANUT OILS).

Station No.	Brand.	Price per bottle, cents.	Capacity of bottle, fl. oz.	Specific gravity at 15.5° C.	Refractive Index at 15.5° C.
22289	Armorelli Brand Pure Lucca Oil	25	4.4	.916	1.4710
22084	Barton & Guestier, Bordeaux. Olive Oil Superfine Clarified	25	3.8	.915	1.4706
22262	Barton & Guestier, Bordeaux. Olive Oil Superfine Clarified	25	3.7	.915	1.4707
22273	Beaumarchand Brand, Nice. Virgin Olive Oil, Qualité extra Supérieure	22	4.5	.916	1.4713
22254	Beaumarchand Brand, Nice. Virgin Olive Oil, Qualité extra supérieure	25	4.7	.916	1.4710
22255	Beaumarchand Brand, Nice. Virgin Olive Oil, Qualité extra Supérieure	25	4.7	.916	1.4710
22296	Philip Berio & Co., Lucca. Pure Olive Oil	60	30.5	.916	1.4704
22298	Philip Berio & Co., Lucca. Pure Olive Oil	65	30.5	.916	1.4704
22268	Bertrand Frères, Grasse. Fontenelle Brand Huile d'Olive Extra Surfine	25	3.9	.916	1.4707
22114	J. Blumers & Bro. Olive Oil Qualité Extra	25	3.7	.916	1.4707
22092	Boy Père & Fils, Salon. Olive Oil, Extra Gold, The Duck	20	4.1	.915	1.4704
22295	The F. C. Bushnell Co., New Haven. Butter-Nut Huile d'Olive Qualité Superfine	25	4.7	.916	1.4704
22266	Caron Brand, Virgin Olive Oil, Extra Quality	40	8.9	.916	1.4707
22292	W. A. Castle, Springfield, Mass. Castle's Cream Olive Oil	25	4.7	.916	1.4710
22210	W. A. Castle, Springfield, Mass. Castle Brand Cream Olive Oil	25	4.4	.916	1.4704
22263	Chapnelle & Co., Marseilles. Pure Olive Oil	25	4.2	.916	1.4707
22231	Cochrane & Co., Buffalo, N. Y. Extra Virgin Olive Oil	25	7.1	.916	1.4710
22284	Delice Huile d'Olive Extra Qualité, Bordeaux	40	9.0	.916	1.4710
22097	De Possel Fils, Marseille. Virgin Olive Oil	40	7.5	.916	1.4707
22244	Falcon Packing Co., New York. Delviso Brand, Pure Olive Oil	25	4.4	.916	1.4710
22283	Ferrier Brand, Preignac. Strictly Pure Olive Oil	20	4.0	.916	1.4710
22294	Ferrier Brand, Preignac. Strictly Pure Olive Oil	15	2.3	.916	1.4707
22098	Gilbert Brand Olive Oil, Nice	25	4.2	.918	1.4704
22261	The Great Atlantic & Pacific Tea Co., New York. A. & P. Brand Huile d'Olive	23	4.1	.916	1.4710

TABLE XXII.—OLIVE OIL (CONTAINING NO COTTON SEED, SESAME OR PEANUT OILS)—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Capacity of bottle, fl. oz.	Specific gravity at 15.5°C.	Refractive Index at 25°C.
22291	A. Guilhon Frère Aîne, Bordeaux. Finest French Olive Oil	25	4.7	.916	1.4710
22274	J. Guiraud & Cie., Marseille. Trauda Brand Pure Olive Oil	23	4.8	.916	1.4710
22269	Edward E. Hall & Son, New Haven. Italian Olive Oil	35	8.3	.916	1.4707
22211	H. J. Heinz Co., Pittsburgh. Pure Olive Oil	30	7.7	.917	1.4704
22293	Lalance Brand, Marseille. Finest Sublime Olive Oil	25	4.7	.916	1.4707
22193	A. Lombardi & Co., Marseilles. Pure Lucca Oil	25	5.0	.916	1.4704
22297	Luigi fu Co., Matteucci, Lucca. Sublime Olive Oil	75	32.3	.916	1.4704
22230	Nicelle Olive Oil Co., New York. White Label Brand Nicelle Olive Oil	25	4.5	.916	1.4710
22290	Olive Growers Association, Los Angeles, Cal. Sylmar Brand Pure California Olive Oil	35	5.3	.916	1.4710
22245	James G. Powers & Co., New York. Red Shield Brand Olive Oil	25	5.0	.916	1.4707
22115	L. A. Price, Bordeaux. Hnile d'Olive Vièrge, Qualité Extra Supérieure	10	2.1	.916	1.4704
22187	S. Rae & Co., Leghorn. *Finest Sublime Lucca Oil*	25	4.6	.916	1.4704
22199	S. Rae & Co., Leghorn. Finest Sublime Lucca Oil	25	3.9	.915	1.4704
22299	Alfonso Romani, Lucca. Pure Olive Oil Superfine	60	33.3	.917	1.4704
22267	Roulan Brand Huile d'Olive Superfine Clarifiée	25	4.7	.916	1.4707
22256	Seeman Bros., New York. La-Rose Blanche Brand Triple Clarified Olive Oil	25	4.4	.916	1.4707
22275	George W. Smith, Bridgeport. Sublime Olive Oil	20	5.0	.916	1.4710
22116	Triat Brand Virgin Olive Oil, Bordeaux	25	4.8	.916	1.4704
22229	Vermiglio, Mazzitelli & Co., Messina. Pure Italian Olive Oil	25	4.8	.916	1.4704
22214	R. C. Williams & Co. Ternay Brand Pure Olive Oil	25	4.9	.916	1.4704

The quality of the oil sold by druggists has also improved, although as late as 1907 over one-seventh was still found adulterated with either cottonseed or sesame oils. The effect of the law on correct labeling is shown by the fact that in 1905 thirteen and in 1906 eleven samples were labeled "compound," which in the past had been sold as pure olive oil.

PICKLES.

Thirty-four samples of pickles and relishes were analyzed; twenty-two of these were sold as sweet pickles.

The labels on eighteen of the samples indicated their compound nature, while on the remaining sixteen there was no indication of the use of prohibited preservatives or artificial sweeteners. The labels claimed that eight samples contained alum, seventeen benzoic acid, six saccharin, and six turmeric or other vegetable color, either alone or in combination.

The analyses, as given in Table XXIII, show that fourteen samples were sweetened with sugar, one with glucose, one with saccharin and five with both sugar and saccharin.

Nineteen samples were preserved with benzoic acid or one of its salts. In two of these, **21331** and **21071**, this preservative was not declared on the label.

All but two of the samples contained small quantities of oxid of aluminum, ranging from 0.007 to 0.074 per cent., with an average of 0.030 per cent. None of the samples was colored with copper.

In the absence of published standards for this food product, only five of the samples failed to meet the general requirements of the law. The deficiencies were as follows:

21033. *The Celebrated White Label Pickles,* M. Schoenberg & Co., New York. Guaranteed to be prepared from granulated sugar, etc. It contained no cane sugar, but did contain considerable glucose (1.60 per cent.), and is therefore misbranded.

21331. *Old Virginia Chutney Relish,* McMechen Preserving Co., Wheeling, W. Va., contained benzoic acid, not declared on the label.

21071. *Choice Sweet Pickles,* The Silver Lane Pickle Co., Silver Lane, East Hartford, Conn., contained benzoic acid, not declared on the label.

21002. *Sweet Mixed Pickles,* and **21105,** *Sweet Relish,* Richard Zastrow, New Haven, Conn. Both guaranteed to be preserved with sugar, etc. Neither contained more than a trace of sugar, the sweetening being due almost entirely to saccharin.

The contents of the bottles were carefully separated into solid and liquid portions and each weighed. The solid portion made up from 53 to 100 per cent. of the contents.

SARDINES IN OIL.

The U. S. Department of Agriculture referred the question of the proper labeling of sardines to the Bureau of Fisheries, which reached the following conclusion (F. I. D. 64):

"Commercially the name sardine has come to signify any small, canned clupeoid fish; and the methods of preparation are so various that it is impossible to establish any absolute standard of quality. It appears to this Department that the purposes of the pure-food law will be carried out and the public fully protected if all sardines bear labels showing the place where produced and the nature of the ingredients used in preserving or flavoring the fish."

The above conclusion will be adopted in judging sardines sold in this State. The essential requirements are that the fish shall be small and belong to the clupeoid family, and that the statements on the label regarding the country where they are packed and the oil in which they are packed shall be truthful.

TABLE XXIV.—BRANDS EXAMINED.

Packed in America.

Elephant Brand Superior Quality. L. D. Clark & Sons, Eastport, Me.

Vender Brand American Sardines. Columbian Canning Co., Lubec, Me.

Pennant Brand American Sardines. Farnsworth Packing Co., Brooklin, Me.

Penobscot Brand American Sardines. Farnsworth Packing Co., Brooklin, Me.

Blue Ribbon Brand American Sardines. M. E. Holmes Canning Co., Eastport, Me.

Sunrise Sardines. M. E. Holmes Canning Co., Eastport, Me.

Tiger Brand Sardines in Mustard Sauce. Independent Canning Co., Eastport, Me.

Sardines. A. LeCroix & Fils, California Fish Co., Los Angeles, Cal.

Eagle Brand American Sardines. Lubec Manufacturing & Canning Co.,

Indian Chief Brand Sardines. Lubec Sardine Co., Lubec, Me.
Keystone Brand Sardines. Macnichol Packing Co., Eastport, Me.
Ocean Brand American Sardines in Mustard Sauce. Maddocks Packing Co., Boothbay Harbor, Me.
Orphan Boy Brand Sardines. H. Midwood's Sons, Providence, R. I.
Gilded Dome Fancy Sardines. Pierce, Austin & Co., Boston, Mass.
Gold Label Maine Sardines. Edward T. Russell & Co., Prospect Harbor, Me.
Conqueror American Sardines. Seacoast Canning Co., Eastport, Me.
Continental American Sardines. Seacoast Canning Co., Eastport, Me.
Extra Quality Fried Sardines. Sunset Packing Co., West Pembroke, Me.
Sunset Brand Sardines à la Française. Sunset Packing Co., West Pembroke, Me.
V. Bossange Fancy Sardines. Wm. Underwood Co., Boston, Mass.
Alfred Teissier Extra Fancy Sardines. Wm. Underwood Co., Boston, Mass.
Moose-a-bec Brand American Sardines. Wm. Underwood Co., Mt. Desert and Jonesport, Me.

Packed in Austria.

Austrian Sardines. Packed for Menzel & Co., New York.

Packed in France.

Sprats a l'Huile. LeFret & Cie., Nantes.
Kermabon Brand French Sprats, Douarnenez.
Linec Brand French Sprats.
Mon Rêve, Grosset Brand. B. & P. Rolland, Bordeaux.
Napoléon Little Fish de Luxe à l'Huile, Douarnenez.
Poissons a l'Huile. L. LeGlizic, Douarnenez.

Packed in Great Britain.

La Princesse Sprats in Oil.

Packed in Norway.

Jupiter Brand Smoked Norwegian Sardines, Bergen.
Larsen Brand Norwegian Smoked Sardines.
Peer Gynt Brand Sardines. H. Heljesen, Sunde.
Smoked Norwegian Sardines. Ronneberg's Preserving Co., Stavanger.
Smoked Norwegian Sardines. Ronneberg's Preserving Co., Stavanger.

Packed in Portugal.

Bon Jean Brand Sardines Extra Quality.
Great Boat Race Brand Portuguese Sardines.
Landel Brand Portuguese Sardines, Olkão.
Mariannic Sardines a l'Huile.
Marzan Brand Portuguese Sardines, Cezimbra.

Packed in Spain.

L'Union Ibérique Brand Spanish Sardines. Jean B. Ceroneira, Vigo.
Sardines Extra Fine. L'Union Ibérique, Vigo.
Tour de Monde Sardines. J. G. G. Rianjo, Coruña.

Packed in Sweden.

The Lighthouse Brand Smoked Sardines. The Swedish Preserving Union, Gothenburg.

The forty-four samples were all found to be small clupeoid fish, either true sardines, herring, menhaden or sprats.

The number of fish per can varied from 5 to 32; the average length of the fish, exclusive of the head which was rarely present, from 2 to 6 inches, and the average weight of the fish from 2.7 to 19 grams. The number of fish usually varied inversely with the size of the fish.

When separated as well as can be by careful draining, the oil made up from 5 to 26 per cent. of the weight of the total contents of the cans, averaging about 14 per cent. Two samples consisted of sardines packed in mustard sauce, and in these it was impossible to determine the net weight of the fish.

The selling price ranged from 5 to 15 cents per can, the size of the fish and the kind of oil used appearing to be the determining factors, rather than the weight of fish sold. The smaller fish, presumably fish of more delicate flavor, as a rule commanded the higher price.

According to the labels of the cans the fish were packed in eight different countries, twenty-two in America, chiefly in Maine; one in Austria, six in France, one in Great Britain, five in Norway, five in Portugal, three in Spain and one in Sweden. Aside from the general appearance of the fish, we have no way to prove the accuracy of these statements; the character of the fish, length, size and weight, indicated that the country of packing was correctly stated in all cases.

The claims as to the oil used in packing were, twelve cottonseed, twelve olive, three peanut, one salad, and fourteen no oil specified. We found nineteen packed in cottonseed oil, one in cottonseed and sesame, fourteen in olive, eight in peanut; two samples were packed in mustard sauce.

Of the twelve samples claimed to contain cottonseed oil, that oil was found in every case. Of the twelve samples claimed to con-

Station No.	Brand.	Price per box in cents.	grams.		Nature of Fish.			Butyro-refractometer at 15.5° C.	Nature of Oil.	
			Fish.	Oil.	Number.	Average weight, gms.	Average length, ins.		Claimed.	Found.
	Packed in America.									
22249	Elephant Brand	5	104	25	7	14.9	4-5	1.4738	Best Salad	Cotton Seed
22242	Vender Brand	10	120	17	10	12.0	4	1.4737	Cotton Seed	Cotton Seed
22222	Pennant Brand	7	95	20	10	9.5	4	1.4744	Cotton Seed	Cotton Seed
22104	Penobscot Brand	5	111	20	7	15.9	6	1.4747	Cotton Seed	Cotton Seed
22200	Blue Ribbon Brand	10	114	11	17	6.7	4	1.4738	Cotton Seed	Cotton Seed
22096	Sunrise	5	114	8	6	19.0	3.5-4	1.4732	Cotton Seed	Cotton Seed
22182	Tiger Brand	10	*290	....	13	....	6	...	Mustard (Sauce)	....
22223	Le Croix	15	130	20	24	5.4	3	1.4744	Olive	Cotton Seed
22066	Eagle Brand	5	104	11	17	6.1	2.5-3.5	1.4739	Cotton Seed	Cotton Seed
22247	Indian Chief Brand	5	98	13	14	7.0	3	1.4738	Cotton Seed	Cotton Seed
22105	Keystone Brand	5	108	15	13	8.3	4	1.4735	Cotton Seed	Cotton Seed
22209	Ocean Brand	10	*300	....	5	....	6	....	Mustard (Sauce)	....
22191	Orphan Boy Brand	10	177	18	29	6.1	4	1.4741	Not Specified	Cotton Seed
22287	Gilded Dome	10	141	22	14	10.1	4	1.4738	Not Specified	Cotton Seed and Sesame
22069	Gold Label	8	102	25	10	10.2	3-3.5	1.4743	Cotton Seed	Cotton Seed
22107	Conqueror	5	103	10	13	7.9	4	1.4741	Cotton Seed	Cotton Seed
22183	Continental	5	80	15	10	8.0	4	1.4741	Cotton Seed	Cotton Seed
22106	Sunset, Extra Quality	9	150	18	12	12.5	5	1.4741	Not Specified	Cotton Seed
22232	Sunset Brand	10	103	20	10	10.3	3	1.4744	Not Specified	Cotton Seed
22288	V. Bossange	9	105	29	16	6.6	4	1.4741	Not Specified	Cotton Seed
22243	Alfred Teissier	10	107	24	21	5.1	3	1.4744	Not Specified	Cotton Seed
22071	Moose-a-bec	10	117	18	5	23.4	3.5	1.4743	Cotton Seed	Cotton Seed
	Packed in Austria.									
22094	Menzel	10	106	14	6	17.7	4	1.4726	Olive	Olive
	Packed in France.									
22281	Le Fret	10	72	15	9	8.0	3.5	1.4735	Peanut	Peanut
22072	Kermabon Brand	10	73	11	12	6.1	3.5	1.4724	Peanut	Peanut

* Packed in mustard sauce; could not separate.

TABLE XXV.—SARDINES IN OIL—*Continued.*

Station No.	Brand.	Price per box in cents.	Net weight grams. Fish.	Net weight grams. Oil.	Nature of Fish. Number.	Nature of Fish. Average weight, gms.	Nature of Fish. Average length, ins.	Butyro-refractometer at 15.5° C.	Nature of Oil. Claimed.	Nature of Oil. Found.
	Packed in France.									
22102	Linec Brand	13	84	12	12	7.0	2.5	1.4723	Peanut	Peanut
22070	Grosset Brand	10	88	15	16	5.5	3-3.5	1.4727	Not Specified	Peanut
22101	Napoléon	10	68	15	21	3.2	2-2.5	1.4717	Not Specified	Peanut
22095	Le Glizic	13	59	21	21	2.8	2	1.4723	Not Specified	Peanut
	Packed in Great Britain.									
22215	La Princesse	10	90	20	10	9.0	4	1.4726	Not Specified	Peanut
	Packed in Norway.									
22065	Jupiter Brand	10	86	24	32	2.7	2-3	1.4725	Olive	Olive
22087	Larsen Brand	15	100	18	17	6.5	2.5-3	1.4722	Olive	Olive
22248	Peer Gynt Brand	10	96	11	18	5.3	3	1.4738	Olive	Olive
22190	Ronneberg	13	97	18	28	3.5	3	1.4741	Olive	Olive (?)
22201	Ronneberg	15	86	19	28	3.1	3	1.4726	Olive	Olive
	Packed in Portugal.									
22086	Bon Jean Brand	10	88	13	10	8.8	3	1.4734	Not Specified	Olive (?)
22251	Great Boat Race Brand	10	102	19	12	8.5	3.5	1.4738	Olive	Olive
22068	Landel Brand	10	109	9	17	6.4	3	1.4719	Olive	Olive
22093	Mariannic	14	108	7	10	10.8	3-3.5	1.4728	Not specified	Peanut
22108	Marzan Brand	10	100	20	13	7.7	4	1.4723	Olive	Olive
	Packed in Spain.									
22100	L'Union Ibérique	10	92	25	11	8.4	3.5	1.4710	Olive	Olive
22208	L'Union Ibérique	15	151	7	13	11.6	4	1.4726	Olive	Olive
22282	Tour de Monde	10	102	15	7	14.6	4	1.4750	Not Specified	Olive (?)
	Packed in Sweden.									
22067	Lighthouse Brand	12	96	14	18	5.3	2.5-3	1.4733	Not Specified	Olive

tain olive oil, eleven contained olive and one cottonseed oil. The three samples claimed to contain peanut oil contained that oil. Of the fifteen samples in which the kind of oil was not specified, six contained cottonseed, one a mixture of cottonseed and sesame, five peanut and three olive oil. While it is desirable that the kind of oil should be stated, this is not obligatory, but when it is stated the statement must be correct, or the sample is misbranded.

The only sample, therefore, that can be classed as misbranded is **22223**, whose label read as follows: *Sardines in Olive Oil, California Fish Co., Los Angeles, Cal., A. Le Croix and Fils.* In this sample cottonseed, not olive, oil was used.

It is interesting to note that all of the American samples were packed in cottonseed oil, except the two where mustard sauce was used; all the French and the single British in peanut oil; all the Norwegian, Spanish, the single Austrian and Swedish, and four of the five Portuguese in olive oil, the fifth Portuguese in peanut oil.

The following summary shows the average characteristics of the sardines attributed to the different countries:

	Selling Price. cts.	Net Weight. gms.	Weight of Fish. gms.	Weight of Oil. gms.	No. of Fish.	Average Weight of Fish. gms.	Average Length of Fish. inches.
American	7.9	132	114	18	13	8.8	3.9
Austrian	10.0	120	106	14	6	17.7	4.0
French	11.0	89	74	15	15	4.9	2.8
British	10.0	110	90	20	10	9.0	4.0
Norwegian	12.6	113	95	18	25	3.8	2.9
Portuguese	10.8	115	101	14	12	8.4	3.8
Spanish	11.7	131	115	16	10	11.5	3.8
Swedish	12.0	110	96	14	18	5.3	2.8

SAUSAGE.

The standard for sausage is as follows:

"*Sausage, sausage meat,* is a comminuted meat from neat cattle or swine, or a mixture of such meats, either fresh, salted, pickled or smoked, with added salt and spices and with or without the addition of edible animal fats, blood and sugar, or subsequent smoking. It contains no larger amount of water than the meats from which it is prepared contain when in their fresh condition, and if it bears a name descriptive of kind, composition or origin, it corresponds to such descriptive name. All animal tissues used as containers, such as casings, stomachs, etc., are clean and sound and impart to the contents no other substance than salt."

TABLE XXVI—PORK SAUSAGE.

Station No.	Brand.	Dealer.	Price per lb.	Water.	Starch from Sources other than Condiments.
			cts.		
21926	Made by dealer	*Waterbury:* Albert Hley	12	47.86	Considerable corn
22020	Deerfoot Farm, Southborough, Mass.	*New Haven:* E. E. Hall	25	36.55	Small amount corn
21924	" " " "	*Waterbury:* H. B. Sanderson	25	38.39	Small amount corn
21907	Hammond	*Bridgeport:* H. Isenberg & Co.	14	41.73	Much corn
21908	"	*Bridgeport:* G. H. Moorey	12	44.19	Considerable corn
21893	S. J. Hugo & Sons, New Haven	*New Haven:* S. J. Hugo & Sons	15	56.91	Medium corn
21900	" " "	*New Haven:* Harry Benjamin	15	57.82	Small amount corn
21918	" " "	*Derby:* Schuessler's Delicatessen	18	58.11	Small amount corn
21937	Made by dealer	*Stamford:* E. P. Jordan	12	42.39	None
22014	Lenox Farm	*New Haven:* D. M. Welch & Son	16	40.80	Small amount corn
22019	" "	*New Haven:* The Mohican Co.	18	35.34	Small amount corn
21904	Mueller	*Bridgeport:* D. E. McNamara	10	39.29	Considerable corn
21906	"	*Bridgeport:* The Union Market	10	40.38	Much corn
21938	"	*Stamford:* P. Hoffman	12	43.22	Much corn
21909	Made by dealer	*Bridgeport:* M. M. Nagel	18	56.05	Hardly any
21910	North Star	*Bridgeport:* Public Market	17	33.16	Hardly any
21897	Made by dealer	*New Haven:* L. Pfaff & Son	15	44.03	Considerable potato
21896	J. P. Squires, Boston	*New Haven:* Broadway Cash Market	10	47.47	Considerable corn
21902	Brookfield Brand, Swift & Co.	*Bridgeport:* Public Market	18	37.63	None
22017	Columbia Brand, Sperry & Barnes (?)	*New Haven:* E. Schoenberger & Sons	9	42.74	Considerable corn
22018	* " " " "	*New Haven:* Geo. Chitty	10	48.38	Considerable corn
22021	" " " " (?)	*New Haven:* E. Schoenberger & Sons	9	42.85	Small amount corn
21888	Standard Brand, " "	*New Haven:* Louis Loeffels	16	37.48	None
22015	†Superior Brand, " "	*New Haven:* A. Basserman	14	38.48	None
22016	" " " "	*New Haven:* H. J. Finnigan	14	35.98	Small amount corn
21962	Sperry & Barnes	*Danbury:* M. J. Barrett	16	32.99	Much corn

* Marked Sausage with cereal. † Marked Sausage with 5% cereal.

TABLE XXVI—PORK SAUSAGE—*Continued.*

Station No.	Brand.	Dealer.	Price per lb.	Water.	Starch from Sources other than Condiments.
			cts.		
21948	Sperry & Barnes	*Norwalk:* Adams Provision Co.	16	33.92	Considerable corn
21949	" "	*So. Norwalk:* Public Market	16	34.37	Small amount corn
21915	" "	*Ansonia:* P. W. Fogarty	14	34.41	None
21898	" "	*New Haven:* A. A. Eisele	15	36.01	Considerable corn
21940	" "	*Stamford:* C. E. Knapp	18	38.36	None
21885	" "	*New Haven:* Booth Meat Co.	12	39.33	Considerable corn & potato
21887	" "	*New Haven:* E. Berhuter	12	39.42	Considerable corn
21899	" "	*New Haven:* E. Schoenberger & Sons	10	41.35	Considerable corn
21939	" "	*Stamford:* D. I. Graf	12	41.83	Much corn
21917	" "	*Ansonia:* A. C. Christensen	12	41.84	Considerable corn
21894	" "	*New Haven:* B. Apler	12	42.81	Much corn
22022	" "	*New Haven:* G. H. Youngerman	12	46.51	Medium corn
21903	" "	*Bridgeport:* The Central Market	10	43.54	None
21925	" "	*Waterbury:* Rush Bros.	12	43.93	Considerable corn
21916	" "	*Ansonia:* Ansonia Trading Co.	14	44.54	Considerable corn
21905	" "	*Bridgeport:* Newfield Market	12	44.99	Small amount corn
22023	" "	*New Haven:* Booth Meat Co.	12	43.22	Very little corn
21928	" "	*Waterbury:* A. J. Dauch	12	47.84	Hardly any
21923	" "	*Waterbury:* Dauch & Weir	12	50.12	Considerable potato
21886	Manufacturer unknown	*New Haven:* A. Duhan	14	39.00	Considerable corn
21895	" "	*New Haven:* E. Schoenberger & Sons	10	41.92	Much corn
21919	" "	*Derby:* H. N. Atwood	12	44.71	Medium corn
21927	" "	*Waterbury:* Model Market Co.	12	43.78	Medium corn
21950	" "	*Norwalk:* Whitlock's Market	16	35.20	Considerable corn
21963	" "	*Danbury:* People's Cash Market	14	46.20	None

Fifty-one samples of pork sausage were examined. No tests were made for preservatives, which are quite commonly used with this material, the examination being limited to the determination of water and the detection of non-condimental starch.

This method of examination was suggested by the frequent claim that starchy material is added to sausage to increase its water-holding power, and thereby decrease the actual amount of meat delivered to the consumer.

Mayrhofer's* method, a provisional method of the Association of Official Agricultural Chemists, was given a thorough trial. Not only did it yield discordant results, but in certain samples, where abundant starch was shown to be present by the microscope, this method gave mere traces. The results secured, believed to be below the actual content of starch, are therefore not published in Table XXVI. The starch determined in thirty-one samples ranged from a trace to 2.36 per cent., with an average of 0.73 per cent.; only eight samples contained more than 1 per cent.

All the samples were examined under the microscope for starches other than condimental with the following results: Eight contained none, eighteen small amounts, eighteen considerable and seven much starch. Forty samples contained cornstarch, two potato starch, and one both corn and potato starch.

The percentage of water ranged from 32.99 to 58.11, with an average of 42.52. The relation of water and starch content is shown in the following tabulation:

Starch.	*Water.* Max.	Min.	Ave.
Much	43.22	32.99	40.70
Considerable	50.12	33.92	42.15
Small amount	58.11	33.16	44.30
None	46.20	34.41	39.81

Contrary to the usual supposition, the presence of added starch seems to have had but little influence on the water content, for the average water in eight samples containing no starch is only slightly less than that in seven containing the most starch, and none of the latter reach the maximum figure, 46.20, found in one "no starch" sample. Furthermore, of the four samples showing the highest water content, 56.91, 57.82, 58.11 and 56.05, three contain only small amounts of starch, and the fourth

* Forschungs-Ber. Lebensm., 1896, *3*, 141; 1897, *4*, 47.

only medium amounts. On the other hand, eight samples, showing much or considerable starch under the microscope, contained less than 40 per cent. of water, three of them less than 35 per cent. The highest water found, 58.11 per cent., was in a sample containing only a small amount of starch; the lowest water, 32.99 per cent., in a sample containing much starch. Lean meat has high water-absorption powers and it would seem from the analyses here recorded that the relative amounts of lean and fat meat in the sausage mixture had quite as much as, if not more, influence on the water content than the cereal or potato starch added.

"TEMPERANCE" DRINKS.

Eleven samples of the so-called "temperance" drinks were analyzed. These were examined as to alcohol, the nature of the sweetening agent, coloring matter and preservatives.

Two samples, "Raspberry Shrub" and "Wine Mint," were stated on the label to contain benzoic acid. Neither benzoic nor salicylic acid were fonnd in any of the other samples.

"Wine Mint," "Coco Cola" and one sample of "Ron-Bre" contained over 1 per cent of alcohol, while both samples of "Iron Brew" and the second sample of "Ron-Bre" contained smaller amounts. "Kolox," "Moxie" and "Phenix" contained no alcohol.

The coloring was artificial in every case; in three samples a coal-tar dye was used, in the others caramel.

The solid matter ranged from 0.60 to 64.41 per cent., consisting almost entirely of sugar in all cases. "Ruby Vim Syrup," "Raspberry Shrub," "Wine Mint" and "Coco Cola" contained over 50 per cent. of solids; all of the other samples contained less than 10 per cent.

Saccharin was found in one sample of "Ron Bre." This sample was a remarkably dilute preparation, consisting essentially of water containing traces of sugar and iron, colored with caramel and sweetened with saccharin.

"Coco Cola" contained the active drug caffeine.

The "iron" preparations, "Iron Brew" and "Ron Bre," the latter apparently an abbreviation of the former, contained mere traces of iron. The two analyses of "Ron Bre" show it to be an extremely weak preparation of varying composition.

TABLE XXVII.—ANALYSES OF "TEMPERANCE" DRINKS.

Station No.	Brand.	Price per bottle.	Specific gravity at 15.6° C.	Alcohol by volume.	Solids.	Cane Sugar.	Invert Sugar.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature °C.	Color.	Preservative.
20981	Ruby Vim Syrup. The Buckingham Pharmacy, Waterbury	15	....	....	61.59	1.1	61.8	−16.6	−18.0	25	Artificial	....
21248	Raspberry Shrub. Curtis & Moore, Boston, Mass.	25	....	....	64.23	19.3	40.1	7.8	−17.4	25	Artificial	*Benzoic acid
21167	Wine Mint. Curtis & Moore, Boston, Mass.	25	1.3131	1.28	64.41	35.5	24.8	28.4	−17.8	25	Artificial	*Benzoic acid
21192	Kolox Undina Brand. The Granite Rock Spring, Higganum	13	1.0361	0.00	9.17	7.1	0.3	7.0	−2.2	25	Caramel	None
20925	Moxie Nerve Food. Moxie Nerve Food Co. of New England, Boston & New York	20	1.0252	0.00	6.49	3.7	1.0	4.0	−0.9	25	Caramel	None
21285	Phenix. Puritan Carbonating Co., Millis, Mass.	15	1.0190	0.00	5.04	4.1	0.3	4.2	−1.2	25	Caramel	None
21072	Coco Cola. (Druggist's label)	15	1.2492	1.38	50.42	1.3	47.8	−12.4	−14.1	25	†Caramel (?)	None
21102	Iron Brew. Bottled by E. F. Blakeslee, New Haven	5	1.0357	0.47	8.32	2.2	4.5	1.0	−1.9	25	‡Caramel	None
21236	Iron Brew. Bottled by Albert O. Neff, Mystic	5	1.0356	0.32	8.44	5.8	4.9	4.4	−3.2	25	‡Caramel	None
21170	Ron-Bre. Sold by Gigliotti Bros., Danbury	5	1.0148	1.05	3.76	1.5	1.0	1.2	−0.8	25	‡Caramel	None
21164	Ron-Bre. Sold by Candy Kitchen, So. Norwalk	10	1.0023	0.41	0.60	0.1	0.0	0.2	0.1	25	‡Caramel	§None

* Declared on label. † Caffeine present. ‡ Contains traces of iron. § Saccharin present.

VANILLA EXTRACT.

The standard for vanilla extract is as follows:

"*Vanilla extract* is the flavoring extract prepared from vanilla bean, with or without sugar or glycerin, and contains in one hundred (100) cubic centimeters the soluble matters from not less than ten (10) grams of the vanilla bean."

This standard does not state definitely the amount of vanillin that should be present, but it does exclude synthetic vanillin, coumarin and caramel, or other artificial coloring matter.

Five vanilla extracts, made by Winton and Silverman at this station,* from beans of different grades, contained from 0.065 to 0.215 per cent. of vanillin. Leach† found in the examination of a large number of brands that gave every indication of purity, that the vanillin varied from 0.050 to 0.200 per cent., so that we may safely conclude that an extract containing much more than 0.20 per cent. of vanillin contains artificial vanillin. It must be remembered that the vanillin content does not altogether determine the value of an extract, as the minute quantities of various resins and other extractive matters, always present in a pure extract, have an important influence on the delicacy of its flavor and aroma.

Sixty-five samples were examined this year, and the analyses are shown in Tables XXVIII, XXIX and XXX, together with seven samples collected by the Dairy Commissioner.

Forty-one of these samples were not found to be adulterated, two were artificially colored, and one of these also adulterated with coumarin, twelve were compounds illegally labeled, and seventeen were compounds or imitations labeled in conformity with the law.

In the extracts classed as not adulterated the vanillin ranged from 0.11 to 0.29 per cent., with an average of 0.20, the figures in no case being sufficiently high to warrant with certainty the conclusion that synthetic vanillin had been used. Moreover, the appearance of the lead acetate precipitate was normal in all cases. None of these samples contained over 0.02 per

* Report, 1901, 150.
† "Food Inspection and Analysis," 1904, 732.

[illegible]—VANILLA EXTRACT NOT FOUND ADULTERATED.*

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Vanillin.
			cts.	fl. oz.	
21932	Finest Extract of Vanilla. Acker, Merrall & Condit Co., New York	*Stamford:* Acker, Merrall & Condit Co.	50	4.3	0.24
2745	Arthur's Pure Extract of Vanilla. The 5c. and 10c. Drug Cabinet Co., New Haven	*New Haven:* The 5c. and 10c. Drug Cabinet Co.	10	1.1	0.22
22085	Banquet Vanilla. Austin, Nichols & Co., New York	*New Haven:* Kohn Bros.	10	1.5	0.15
21873	Republic Extract Vanilla. Austin, Nichols & Co., New York	*Bridgeport:* Joseph Keegan	25	2.1	0.25
21844	Pure Extract Vanilla. Baker Extract Co., Springfield, Mass.	*New Haven:* R. F. Copeland	25	1.9	0.14
22213	Old Homestead Flavoring Extracts Vanilla. Bennett, Sloan & Co., New York				
21657	Extract Vanilla. Joseph Burnett Co., Boston, Mass.	*Willimantic:* W. D. Casey	10	1.0	0.23
21934	Pure Extract of Vanilla. W. Burton & Co., New York	*New Haven:* E. E. Hall & Son	50	4.0	0.23
21957	Pure Extract of Vanilla. W. Burton & Co., New York	*Stamford:* Empire State Tea Co.	15	1.7	0.22
21930	Pure Extract Vanilla. J. M. Carolan & Co., New York	*So. Norwalk:* A. F. Beckman & Co.	10	1.1	0.23
21650	Charter Oak Brand Pure Vanilla. Made at Hartford, Conn.	*Stamford:* N. Y. Cash Grocery Co.	18	2.1	0.24
21653	Charter Oak Brand Pure Vanilla. Made at Hartford, Conn.	*New Haven:* C. F. Clark	10	1.1	0.28
21872	Mayflower Extract Pure Vanilla. The A. Colburn Co., Philadelphia	*New Haven:* Cushman Cash Co.	10	0.9	0.27
21956	Mayflower Extract Pure Vanilla. The A. Colburn Co., Philadelphia	*Bridgeport:* H. Isenberg & Co.	10	1.0	0.15
22077	Vanilla Extract. Colgate & Co., New York	*Norwalk:* Grand Central Grocery	10	1.0	0.22
22216	Fine Flavors Vanilla. W. M. Crawford, Stafford Springs	*New Haven:* H. Hahn	25	2.2	0.21
21912	Country Club Pure Extract Vanilla. The John T. Doyle Co., New Haven	*Stafford Springs:* Andrew Whiton	25	2.0	0.11
22110	Davisco Brand Vanilla. F. H. Davis & Co., New London	*Bridgeport:* Newfield Market	10	1.2	0.19
21649	Foss' Pure Extract Vanilla	*New London:* F. H. Davis & Co. ‡	25	2.2	0.19
2673	Foss' Pure Extract Vanilla	*New Haven:* W. D. Minor	25	1.9	0.24
		Willimantic: Milton Hall	25	2.1	0.19

* None of these samples contained coumarin or artificial color.

‡ Guaranteed three-fifths standard [illegible]

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Vanillin.
			cts.	fl. oz.	
21967	Acme Pure Extract of Vanilla. Edwin J. Gillies & Co., New York	*Danbury:* M. J. Shanley	20	2.1	0.18
21884	Gold Seal Brand Extract Pure Vanilla	*Waterbury:* Model Market Co.	10	1.0	0.11
21859	Good Value Extract Pure Vanilla. Binghamton, N. Y.	*New Haven:* P. Leshine	10	1.1	0.13
22188	Helmet Brand Pure Vanilla	*Norwich:* McCarthy Bros.	10	1.1	0.20
21869	Howco Pure Flavoring Extracts Vanilla	*Bridgeport:* Howland Dry Goods Co.	18	1.8	0.13
21874	Nabob Flavoring Extracts Vanilla. Francis H. Leggett & Co., New York	*Bridgeport:* Pike Bros. Co.	20	2.0	0.18
3010	Concentrated Fruit Extract Vanilla. The McKee Medicine Co., Middletown, Conn.	*Middletown:* A. M. Bidwell	25	2.0	0.14
21832	Vanilla. McMonagle & Rogers, Middletown, N. Y.	*New Haven:* John Gilbert & Son	55	4.0	0.18
21929	Extract of Vanilla. The Miller Mfg. Co., New York	*Stamford:* W. W. Waterbury	40	3.9	0.25
21830	Mohican Pure Extract of Vanilla	*New Haven:* The Mohican Co.	25	3.6	0.17
21870	Monogram Brand Pure Vanilla	*Bridgeport:* Public Market Co.	45	3.8	0.28
21656	Patca Brand Pure Extract of Vanilla. Patterson-Cabell Co., Jersey City, N. J.	*New Haven:* Mendel & Freedman	10	1.9	0.16
21829	Puritan Extract of Vanilla. Puritan Drug Co., Boston	*New Haven:* M. C. Dingwall	25	2.0	0.14
21652	Pure Concentrated Extract Vanilla. The C. F. Sauer Co., Richmond, Va.	*New Haven:* S. S. Adams	10	0.9	0.29
21867	Pure Highly Conc. Extract Vanilla. G. W. Smith, Bridgeport	*Bridgeport:* Village Store Co.	15	2.1	†0.17
21959	Extract Pure Vanilla. J. E. Thompson, New York	*Norwalk:* F. D. Lawton	25	2.1	0.27
21968	Highly Concentrated Vanilla. VanDuzer Extract Co., New York	*Danbury:* Ehle's Cash Grocery	25	2.0	0.27
21833	Ambassador Brand Extract of Vanilla. James Van Dyk Co., New York	*New Haven:* VanDyk Tea and Coffee Co.	19	1.9	0.19
21922	Delicious Flavoring Extracts Vanilla. Dist. by J. D. Welch & Co., New Haven	*Ansonia:* D. M. Welch & Son	20	1.8	0.26
21883	Pure Flavoring Extracts Vanilla. Worth Extract Co., New York	*Waterbury:* Mrs. Moore	10	1.0	0.17
21964	Pure Flavoring Extracts Vanilla. Worth Extract Co., New York	*Danbury:* Danbury Grocery	15	2.3	0.17

* None of these samples contained coumarin or artificial color. † Guaranteed three-fifths standard strength.

Table XXIX.—Adulterated or Illegally Labeled Compound Vanilla Extract.

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Vanillin.	Coumarin.	Color
	Adulterated.		cts.	fl. oz.			
21831	Searle's Concentrated Extracts Vanilla. Hetfield & Searle Extract Co., New York	*New Haven:* U. L. Frank Tea Co.	15	2.2	0.23	0.05	Artificial
21655	Premium Brand Vanilla, Full Standard Strength	*New Haven:* Carlson Tea and Butter Co.	25	1.7	0.11	0.00	Artificial
	Illegally Labeled.						
21876	Centennial Highly Concentrated Extract of Vanilla	*Bridgeport:* Centennial Tea Co.	10	1.9	0.02	0.00	Artificial
21850	Blue Bell Brand Compound Vanilla Flavor. The John T. Doyle Co., New Haven	*New Haven:* H. M. Tower	10	1.6	0.26	0.04	Artificial
21875	Premium Brand Extract of Vanilla. East India Tea Co., Bridgeport	*Bridgeport:* East India Tea Co.	15	1.6	0.04	0.03	Artificial
21843	Extra Strength Star Brand Compound Vanillin, Cumarin Vanilla Extract. Wm. J. Fuller & Son, New Haven	*New Haven:* D. M. Welch & Son	10	1.6	0.26	0.06	Artificial
3011	Artificial Extract of Vanilla. The McKee Medicine Co., Middletown	*Middletown:* A. M. Bidwell	10	1.6	0.43	0.08	Artificial
21632	Atwood's Extra Strong Vanilla. New Haven Extract Co., New Haven	*Whitneyville:* O'Connell's Grocery	10	1.0	0.52	0.05	Artificial
21651	Atwood's Extra Strong Vanilla. New Haven Extract Co., New Haven	*New Haven:* Wray & Co.	10	1.2	0.50	0.05	Artificial
22109	Concentrated Compound Extract of Vanilla. Nichols & Harris, New London	*New London:* Reddin's Cash Grocery	25	1.8	0.11	0.04	Artificial
21868	Boston Vanilla Flavoring. Puritan Drug Co., Boston	*Bridgeport:* Wheeler & Co.	10	1.4	0.58	0.12	Artificial
22025	Boston Vanilla Flavoring. Puritan Drug Co., Boston	*Meriden:* McBride & Co.	10	1.6	0.48	0.12	Artificial
21933	Tropic Brand Conc. Extract of Vanilla. The Tropic Co., New York	*Stamford:* Hepton Tea and Coffee Co.	10	1.4	0.12	0.00	Artificial
21871	Sovereign Vanilla Flavoring. The Union Pacific Tea Co., New York	*Bridgeport:* Union Pacific Tea Co.	25	2.1	1.25	0.00	Natural

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Vanillin.	Coumarin.	Color.
			cts.	fl. oz.			
21931	Columbia Brand Imitation Vanilla Flavor	*Stamford:* Columbia Tea Co.	15	1.7	0.13	0.07	Artificial
2688	O. K. Vanilla Flavoring Substitute. The C. L. Cotton Perf. and Extr. Co., Earlville, N. Y.	*Stafford Springs:* T. J. Chandler	10	2.1	0.12	0.11	Artificial
3007	O. K. Vanilla Flavoring Substitute. The C. L. Cotton Perf. and Extr. Co., Earlville, N. Y.	*Meriden:* M. W. Booth	10	1.8	0.12	0.12	Artificial
22026	O. K. Compound Vanilla Substitute. The C. L. Cotton Perf. and Extr. Co., Earlville, N. Y.	*Meriden:* Booth's Grocery	10	1.9	0.11	0.12	Artificial
21911	Crescent Brand Vanilla Substitute	*Bridgeport:* Public Market	10	1.4	0.11	0.05	Artificial
22053	Eden Brand Vanilla Substitute. Lewis DeGroff & Son, New York	*New Britain:* Wm. Foulds	10	1.3	0.11	0.03	Artificial
21936	Harrison Brand Vanilla Substitute. Lewis De Groff & Son, New York	*Stamford:* E. P. Jordon	10	1.6	0.08	0.08	Artificial
21921	Improved Substitute for Vanilla, Eureka Brand. Made at Hartford	*Ansonia:* P. W. Fogarty	10	1.6	0.32	0.05	Artificial
21860	Grand Union Extract Vanilla and Tonka. Grand Union Tea Co., Brooklyn	*New Haven:* Grand Union Tea Co.	20	1.9	0.22	0.03	Natural
21958	20th Century Vanilla Substitute. Jas. G. Powers & Co., New York	*So. Norwalk:* Edwin Wilcox	10	1.3	0.07	0.08	Artificial
22024	Prefect Brand Imitation Flavor of Vanilla. Made at Hartford	*Meriden:* Union Tea Co.	15	1.6	0.27	0.03	Artificial
21920	Sterling Brand Imitation Flavor of Vanilla. Made at Hartford	*Ansonia:* Logan Bros.	15	1.7	0.29	0.04	Artificial
2753	St. John's Imitation Vanilla Flavor. St. John & Co., New York	*New Britain:* D. F. Fickman	10	1.5	0.10	0.06	Artificial
21643	St. John's Imitation Vanilla Flavor. St. John & Co., New York	*New Britain:* D. F. Fickman	10	1.9	0.09	0.07	Artificial
21901	St. John's Vanilla Substitute. St. John & Co., New York	*New Haven:* Harry Benjamin	10	1.7	0.11	0.08	Artificial
21851	Stuart Brand Improved Substitute for Vanilla. Made at Hartford	*New Haven:* Logan Bros.	10	1.8	0.28	0.05	Artificial
22062	Webb's Brand XX Vanilla and Tonka. Prepared at Springfield, Mass.	*New Britain:* Wray & Co.	10	1.5	0.34	0.023	Natural

cent. of coumarin, and no artificial color was observed in any case.

The following extracts were adulterated:

21831. *Searle's Concentrated Extracts Vanilla,* Hetfield & Searle Extract Co., New York, contained coumarin and was artificially colored.

21655. *Premium Brand Vanilla,* Full Standard Strength, contained artificial color.

Illegally Labeled Extracts.

Twelve samples were illegally labeled, as follows:

21876. Not "highly concentrated" as it contained only 0.02 per cent vanillin.

21850. Contains coumarin, which was not indicated in the brand name on the label.

21875. Contains coumarin, which was not indicated in the brand name on the label; an extract much below standard strength.

21843. Technically illegal, as the labels of the carton and bottle do not agree, the artificial color not being indicated on the former. The phrases "extra strength" and "they are known to all who have used them as the BEST" are likewise objectionable.

3011. Synthetic vanillin used, as well as artificial color, but neither stated on the label.

21632 and **21651.** Carton was labeled "Atwood's Extracts are Best (Vanilla) and Strongest"; the bottle was labeled "Atwood's Extra Strong Vanilla Compound. Prune Juice, Burnt Sugar, Vanillin and Coumarin are used in connection with Vanilla Beans to preserve and retain the Vanilla flavor." These two labels in no wise agree; synthetic vanillin was not declared in the brand name and the extracts are not the "best" and "strongest."

22109. Carton labeled "Concentrated Compound Extract Vanilla"; the bottle "Extra Vanilla."

21868 and **22025.** The brand name does not indicate the presence of synthetic vanillin and coumarin, or the artificial color.

21933. The artificial color is not indicated in the brand name.

21871. Synthetic vanillin is not indicated in the brand name.

Legally Labeled Imitations or Substitutes.

Seventeen samples were legally labeled imitations or substitutes; five were marked "imitation," ten "substitute" and two "Vanilla and Tonka Extract." Proper formulas were given in all cases, which were shown to agree with the analysis.

Selling Price and Volume of Bottles.

Fourteen samples guaranteed on the label a net volume ranging from one to four ounces. No serious discrepancy in volume was noted, five guaranteed 4 ounces contained from 3.6 to 4.3 ounces, eight guaranteed 2 ounces contained from 1.8 to 2.2 ounces, and one guaranteed 1 ounce contained 1.1 ounces.

With few exceptions the volume of the extract and the selling price bore a quite constant relation. For instance, in the unadulterated extracts on the average 1.1 ounces was supplied for 10 cents, 2 ounces for 20 cents, 2.2 ounces for 25 cents and 4 ounces for from 40 to 55 cents.

The average selling price per bottle of the unadulterated extracts was 20.7 cents for 1.97 ounces, or 10.5 cents per ounce; in the adulterated extracts 20 cents for 1.95 ounces, or 10.3 cents per ounce; and in the compound extracts 12.1 cents for 1.62 ounces, or 7.5 cents per ounce. The compound extracts are very properly on the average sold for a lower price than the high-grade extracts made from the vanilla bean only.

MISCELLANEOUS FOODS.

22088. Hazeldell Brand Syrup, Pure Strawberry Syrup, 40 per cent., Pure Apple Syrup, 20 per cent., Pure Corn Syrup, 40 per cent., $^1/_{10}$ of 1 per cent. Benzoate Soda added. Made by The John T. Doyle Co., New Haven. Sold by A. N. Loeb, New Haven. Price, 10 cents per bottle.

It contained 68.13 per cent. total solids, polarization direct at 21°, + 84.0, polarization after inversion at 21°, + 68.9, lead number, 1.08, ash, 0.32.

22258. Delft Peanut Oil. Made by Franco-Dutch Oil Works, Calvé-Delft, Delft, Holland. Sold by Wise, Smith & Co., Hartford. Price, 25 cents per bottle, containing 6.1 ounces.

It showed a specific gravity at 15.6° of 0.916, and a refractive index of 1.4717 at 15.5°. No cottonseed or sesame oil present.

21124. Trumilk, Fresh Milk in Powder Form. Made by Merrell-Soule Co., Syracuse, N. Y. Sold by Atlantic and Pacific Tea Co., Bridgeport. Price, 10 cents per can.

It contained 3.78 per cent. water, and 96.22 total solids, divided as follows: ash, 6.00, protein (N × 6.38), 25.65, fat, 27.36, and lactose, 37.21.

II. DRUG PRODUCTS.

LINIMENTUM CAMPHORAE.

(Camphor Liniment.)

The U. S. P. requires that 200 gms. of camphor and 800 gms. of cottonseed oil be introduced into a suitable flask, and a gentle heat applied, by means of a water bath, loosely stoppering the flask during the operation; the flask should be agitated occasionally until the camphor is dissolved. In other words, the liniment is a 20 per cent. solution of camphor in cottonseed oil.

Owing to the danger of loss of some of the camphor by volatilization when heat is applied, some pharmacists prefer to make the solution in the cold, which requires more time but secures the same product. There is the danger, however, that through carelessness the camphor may not be entirely dissolved and that the material may be dispensed before complete solution is effected. Several of the samples examined this year contained undissolved camphor, showing that this method of preparation had been employed.

The terms "camphor liniment" and "camphorated oil" seem to be used synonymously by Connecticut druggists, the latter name being most generally employed. While in practically every instance "camphor liniment" was asked for at the time of purchase, fully 90 per cent. of the samples were labeled "camphorated oil" when dispensed. It is apparent, therefore, that our druggists consider them the same preparation and that the standard of 20 per cent. camphor should be applied even when the sample is marked "camphorated oil."

Methods of Analysis.

Refractive Index. The refraction of the oil was determined at 25° in the butyro-refractometer w[illegible] purpose

of this determination was the detection of the oil used. It was shown by experiment that the presence of the camphor had but little effect on the refractive index of the liniment, especially when cottonseed oil was used.

Camphor. The results reported in the main tables were secured by heating about 5 grams of the liniment in an aluminum dish on the water bath until the odor of camphor was absent, followed by one-hour periods of heating in the water oven until constant weight was secured. (In some cases a slight increase of weight was observed due to the oxidation of the oil.) The presence of water in the liniment naturally caused high results by this method.

An alternative method, used in connection with the above in the Dairy Commissioner's samples, consisted in the polarization of the liniment in a 100 mm. tube, using a color screen, consisting of a 50 mm. tube containing a 10 per cent. solution of potassium bichromate, to correct for the

Polarization of Camphor in Cotton Seed Oil.

Polarization, 100 mm. (Ventzke).	Camphor per cent.	Polarization, 100 mm. (Ventzke).	Camphor per cent.	Polarization, 100 mm. (Ventzke).	Camphor per cent.	Polarization, 100 mm. (Ventzke).	Camphor per cent.
−0.3	0.0	7.3	5.3	14.5	10.3	21.6	15.3
+0.8	0.8	7.8	5.6	15.0	10.7	22.1	15.7
1.1	1.0	8.3	6.0	15.5	11.0	22.6	16.0
1.6	1.3	8.7	6.3	16.0	11.3	23.1	16.3
2.1	1.7	9.2	6.6	16.5	11.6	23.6	16.7
2.6	2.0	9.7	7.0	16.9	12.0	24.1	17.0
3.0	2.3	10.2	7.3	17.4	12.3	24.6	17.3
3.5	2.6	10.7	7.7	17.9	12.6	25.1	17.6
4.0	3.0	11.2	8.0	18.3	13.0	25.7	18.0
4.5	3.4	11.6	8.3	18.8	13.3	26.2	18.3
5.0	3.7	12.0	8.6	19.2	13.6	26.7	18.7
5.4	4.0	12.6	9.0	19.7	14.0	27.2	19.0
5.9	4.3	13.0	9.3	20.1	14.3	27.5	19.3
6.4	4.6	13.5	9.6	20.6	14.6	28.2	19.7
6.9	5.0	14.0	10.0	21.1	15.0	28.7	20.0

Table XXXI.—Comparative Results on Camphor.

Evaporation.	Polariscope.	Evaporation.	Polariscope.	Evaporation.	Polariscope.
1.1	0.6	10.5	10.0	15.9	15.8
2.8	2.9	10.5	10.1	15.8	16.1
7.3	7.4	10.1	10.3	16.4	16.5
7.9	7.8	10.6	10.9	16.6	16.5
8.9	8.6	11.3	11.2	16.5	17.0
9.2	9.0	12.3	12.3	17.3	17.5
8.9	9.2	13.0	13.0	17.8	17.6
9.7	9.6	13.1	13.1	17.6	17.8
9.5	9.7	13.1	13.2	18.0	17.8
9.7	9.7	13.5	13.5	18.3	18.3
9.7	9.7	14.2	14.3	19.7	19.7
9.8	9.9	14.9	14.9	21.1	21.1

TABLE XXXII.—CAMPHORATED OIL UP TO STANDARD.*

Station No.	Dealer.	Cost per bottle, cents.	Capacity of bottle, fl oz.	Refractive Index at 25° C.	Per cent. of Camphor.
21335	*Ansonia:* The Bristol Drug Co.	10	2	1.4704	18.9
20950	*Bethel:* Chas. J. English	20	2	1.4697	22.7
21390	*Branford:* Hoadley & Hutchinson	15	2	1.4697	21.1
21139	*Bridgeport:* Atlantic Hotel Pharmacy	15	2	1.4702	23.3
21145	Damtoft & Meyer	15	2	1.4704	22.3
21138	Lee's Pharmacy	15	2	1.4700	18.8
21144	J. A. Leverty & Bro.	10	2	1.4700	18.2
21137	Edward Toucey	15	2	1.4694	18.1
21683	*Bristol:* Merriman Bros.	20	2	1.4741	26.5
21783	Bristol Pharmacy	20	2	1.4720	19.8
21682	Perry N. Holley	25	2	1.4697	19.5
21768	*Danielson:* W. W. Woodward	15	2	1.4717	19.4
21765	A. G. Beckley & Co.	20	2	1.4723	19.4
21180	*Danbury:* Phillip Simon	15	2	1.4700	22.9
21178	Doran's Drug Store	20	2	1.4697	21.4
21179	E. W. Baldwin	20	2	1.4696	20.5
21319	*Derby:* G. H. Harding	15	2	1.4700	19.8
21104	*Greenwich:* W. E. Finch	25	4	1.4697	18.6
21279	*Hartford:* Anton Hellman	15	2	1.4697	22.8
21276	D. G. Stoughton & Co.	25	2	1.4700	22.7
21278	The Sissa Pharmacy	10	2	1.4697	22.0
21392	*Litchfield:* Crutchs' Pharmacy	15	2	1.4700	23.9
21393	Pratt's Pharmacy	20	2	1.4697	20.6
21394	J. Wolcott Wheeler	20	2	1.4697	20.2
21412	*Manchester:* W. H. Grant	20	2	1.4704	18.1
21068	*Meriden:* Lamping's Pharmacy	25	2	1.4704	19.9
21065	Meriden House Drug Store	20	2	1.4707	19.2
21067	Graeber's Pharmacy	10	2	1.4704	18.9
21214	*Middletown:* Jos. P. Kinsella	20	2	1.4695	20.3
21761	*Moosup:* J. W. Tuckerman	15	2	1.4723	19.7
21744	*Mystic:* H. N. Wheeler	20	2	1.4704	20.5
21746	Starr Bros. Drug Co.	20	2	1.4700	19.7
21359	*Naugatuck:* John J. Kehoe	15	2	1.4697	23.3
21365	Naugatuck Drug Co.	15	2	1.4697	19.0
21076	*New Britain:* Crowell the Druggist	20	2	1.4700	20.1
21078	Bergquist Bros.	20	2	1.4704	18.5
20939	*New Canaan:* Central Pharmacy	20	2	1.4672	22.0
21116	*New Haven:* Morris Pharmacy	15	2	1.4700	25.7
21314	A. B. Simpkin	15	2	1.4700	21.7
20933	J. Linde & Son	20	4	1.4697	21.1
21293	S. L. Salisbury	13	2	1.4704	21.0
20932	J. M. Jacobs	25	4	1.4700	21.0
20935	E. Wadewitz	35	4	1.4700	20.0
21317	Chas. Fleishner	10	2	1.4797	20.0
21312	A. B. Hall	15	2	1.4704	19.0
20934	Keane's Pharmacy	25	4	1.4710	18.6
20931	A. F. Wood's Sons	25	4	1.4702	18.6
21118	T. J. Beck	15	2	1.4700	18.5

* Includes samples less than 10 per cent. below U. S. P. strength.

TABLE XXXII. — CAMPHORATED OIL UP TO STANDARD* — *Continued.*

Station No.	Dealer.	Cost per bottle, cents.	Capacity of bottle, fl. oz.	Refractive Index at 25° C.	Per cent. of Camphor.
21229	*New London:* McBride's Pharmacy	20	2	1.4700	23.8
21221	Downey's Pharmacy	20	2	1.4700	22.3
21225	Randale's Drug Store	15	2	1.4698	22.2
21226	E. Callahan	15	2	1.4696	21.1
21227	Taylor's Pharmacy	15	2	1.4692	20.5
21228	Sayle's Pharmacy	20	2	1.4700	19.6
20944	*New Milford:* W. N. Noble	20	2	1.4697	21.9
20943	Albert Evitts	25	2	1.4697	19.4
21037	*Norwalk:* H. Glendenning & Co.	35	4	1.4704	19.4
21750	*Norwich:* P. F. Bray	20	2	1.4697	23.2
21751	Bisket & Meech	20	2	1.4697	20.1
21238	John A. Dunn	23	2	1.4704	18.5
21250	The Lee and Osgood Co.	20	2	1.4700	18.1
21775	*Putnum:* Henry L. Burt	10	2	1.4707	25.2
21411	*Rockville:* Fred Woodhall & Co.	15	2	1.4704	22.5
21408	W. H. Sills	15	2	1.4700	19.3
21409	F. E. Metcalf	15	2	1.4700	19.0
21660	*So. Manchester:* The Rapeley Drug Co.	15	2	1.4697	20.7
21413	T. Weldon & Co.	20	2	1.4704	18.1
21030	*Stamford:* C. S. Finch	25	4	1.4704	18.7
21404	*Stafford Springs:* Anders Jacobsen	15	2	1.4697	20.0
21690	*Thompsonville:* John A. Williams	25	2	1.4710	19.0
21691	Geo. R. Steele	25	2	1.4707	18.2
21391	*Torrington:* C. H. Dougal	10	2	1.4704	19.7
21387	*Wallingford:* Geo. A. Smith	10	2	1.4697	21.5
21648	*Waterbury:* Mrs. Moore†	10	-	1.4704	18.9
20989	G. Leslie Dexter & Co.	15	2	1.4704	18.8
20979	West End Drug Store	20	2	1.4723	18.2
20980	Callender & Haggerty	35	4	1.4697	18.1
21687	*Windsor Locks:* J. W. Roberts	15	2	1.4704	19.2
21701	*Winsted:* G. L. Fancher	15	2	1.4700	21.9
21700	C. C. Buck	15	2	1.4700	20.3
21699	The Baird Pharmacy	15	2	1.4704	19.4

* Includes samples less than 10 per cent. below U. S. P. strength.
† Arthur's Camphorated Oil. The Five and Ten Cent Drug Cabinet Co., New Haven.

dispersion of the camphor. The table on page 239, based on one prepared by H. C. Lythgoe,* will be found convenient in calculating results.

The two methods were compared on thirty-six samples with excellent results, as the tabulation shows. The average camphor by the two methods was identical, and the greatest variation was 0.5 per cent.; in twenty-eight of the samples the variation was 0.2 per cent. or less. The polarization method is much quicker and, it is believed, more accurate, as the disturbing effect of the presence of water and easily oxidized oils are thereby eliminated.

* Report, Mass. Board of Health, 1907, p. 380.

TABLE XXXIII.—CAMPHORATED OIL BELOW STANDARD.

Station No.	Dealer.	Cost per bottle, cents.	Capacity of bottle, fl. oz.	Refractive Index at 25° C.	Per cent. of Camphor.	Per cent. U. S. P. Strength.
21336	*Ansonia:* S. W. Smith & Co.	15	2	1.4707	9.6	48.0
20949	*Bethel:* P. J. Garvin	20	2	1.4697	16.4	82.0
21389	*Branford:* John A. Morton	15	2	1.4697	12.2	61.0
21155	*Bridgeport:* J. A. Leverty & Bro.	10	2	1.4702	17.8	89.0
21142	The Cyrus Pharmacy	15	2	1.4700	13.1	65.7
21158	Wilma M. Bachman	15	2	1.4707	6.5	32.5
21143	Dupee's Pharmacy	15	2	1.4705	0.0	0.0
21680	*Bristol:* Madden's Drug Store	15	2	1.4697	13.8	69.0
21681	Perry N. Holly	20	2	1.4697	12.1	60.5
21707	*Canaan:* John L. Thurlough	15	2	1.4704	13.0	65.0
21695	*Collinsville:* H. A. Smith	15	2	1.4697	17.8	89.0
21693	E. A. Hough	15	2	1.4704	15.5	77.5
21696	Geo. F. Lewis	15	2	1.4707	8.2	41.0
21169	*Danbury:* Reed & Co.	15	2	1.4705	17.2	86.0
21767	*Danielson:* The Burroughs Drug Co.	15	2	1.4720	15.9	79.5
21766	L. J. Morin	20	2	1.4723	9.8	49.0
21753	*Greeneville:* John A. Morgan	20	2	1.4723	15.3	76.5
21752	W. J. Galvin & Co.	25	2	1.4735	10.3	51.5
21353	*Hartford:* Rickman Bros.	15	2	1.4697	16.0	80.0
21277	T. J. Blake, Jr.	15	2	1.4700	14.8	74.0
21354	D. W. Tracy	15	2	1.4697	14.8	74.0
21355	D. G. Stoughton & Co.	25	2	1.4700	14.5	72.5
21356	Pike's Drug Store	20	2	1.4694	5.9	29.5
21352	P. J. Cavanaugh	20	2	1.4704	3.9	19.5
21758	*Jewett City:* William Soule	20	2	1.4717	17.3	86.5
21759	L. V. L'Heureaux	20	2	1.4704	15.8	79.0
21659	*Manchester:* Balch & Brown	15	2	1.4697	17.7	88.5
21066	*Meriden:* V. W. Schmelzer	15	2	1.4707	9.6	48.0
21212	*Middletown:* H. N. Lincoln	10	2	1.4672	14 8	74.0
21211	Bergquist Bros.	10	2	1.4698	13.8	69.0
21213	Henry Woodward	10	2	1.4822	9.7	48.5
21762	*Moosup:* W. H. Sargent	15	2	1.4723	7.6	38.0
21745	*Mystic:* Mystic Pharmacy	20	2	1.4697	17.8	89.0
21077	*New Britain:* Halloran's Drug Store	15	2	1.4711	16.8	84.0
21079	Joseph H. Lutz	10	2	1.4710	15.9	79.5
21784	Odell's Pharmacy	20	2	1.4707	7.8	39.0
20940	*New Canaan:* L. M. Monroe	20	2	1.4697	16.9	84.5
21291	*New Haven:* G. D. Farovid	13	2	1.4704	17.9	89.5
21638	Mayer & Loeb*	10	-	1.4700	17.3	86.5
21117	T. J. Lynch	15	2	1.4700	16.0	80.0
21290	T. P. Gillespie & Co.	10	2	1.4704	15.1	75.5
21115	C. A. Lamb	15	2	1.4700	13.0	65.0
21292	C. H. Conway	15	2	1.4710	11.2	56.0
21294	J. T. Hillhouse	15	2	1.4697	10.5	52.5
20930	James A. Notkin	20	4	1.4700	8.9	44.5
21316	James A. Notkin	15	2	1.4697	8.7	43.5
21315	C. P. Cipolla	15	2	1.4697	8.6	43.0
21251	*Norwich:* Wm. H. Nicholson	15	2	1.4703	9.5	47.5

* Arthur's Camphorated Oil. The Five and Ten Cent Drug Cabinet Co., New Haven.

TABLE XXXIII.—CAMPHORATED OIL BELOW STANDARD—*Continued.*

Station No.	Dealer.	Cost per bottle, cents.	Capacity of bottle, fl. oz.	Refractive Index at 25° C.	Per cent. of Camphor.	Per cent. U. S. P. Strength.
21249	*Norwich:* B. A. Herrick	23	2	1.4713	5.1	25.5
21777	*Putnam:* G. E. Dresser	15	2	1.4717	14.3	71.5
21716	Simon Farley	10	2	1.4717	12.0	60.0
21410	*Rockville:* E. F. Wilson	15	2	1.4704	16.3	81.5
21326	*Shelton:* Fred S. Sanford	15	2	1.4707	13.3	66.5
21661	*So. Manchester:* O. L. Wickes & Co.	20	2	1.4697	14.1	70.5
21041	*So. Norwalk:* E. W. Kelley, Jr.	30	2	1.4707	16.8	84.0
21405	*Stafford Springs:* A. C. Eaton	20	2	1.4700	12.0	60.0
21025	*Stamford:* Goulden's Pharmacy	30	2	1.4704	16.6	83.0
21026	Parker & Ward	30	2	1.4710	11.4	57.0
21741	*Stonington:* Burtsch's Drug Store	15	2	1.4672	9.7	48.5
21740	Dr. C. E. Brayton & Co.	15	2	1.4704	7.0	35.0
20962	*Torrington:* Jas. N. Banziger	10	2	1.4700	14.4	72.2
20961	E. W. Nolan	10	2	1.4704	13.4	67.0
20960	Claxton's Pharmacy	10	2	1.4697	9.5	47.5
21386	*Wallingford:* A. B. Pixley	15	2	1.4697	17.9	89.5
21388	J. D. Tucker	15	2	1.4700	16.1	80.5
21385	T. F. Collins	15	2	1.4697	11.2	56.0
20988	*Waterbury:* Apothecaries Hall Co.	15	2	1.4704	16.7	83.5
20994	N. A. Upham	25	2	1.4700	16.4	82.0
20991	McCarthy Pharmacy	10	2	1.4704	14.9	74.5
21737	*Waterville:* T. B. Carney & Co.	25	2	1.4704	11.0	55.0
21738	Geo. A. Sayers	20	2	1.4700	17.3	86.5
21083	*Willimantic:* Leonard's Pharmacy	15	2	1.4668	2.9	14.5
21082	J. J. Hickey & Co.	10	2	1.4675	1.1	5.5
21688	*Windsor Locks:* J. W. Browning	20	2	1.4704	16.9	84.5
21702	*Winsted:* Judson's Pharmacy	15	2	1.4700	17.3	86.5
21704	Phelps' Pharmacy	15	2	1.4768	11.8	59.0
21703	W. H. Mills	10	2	1.4777	9.0	45.0

It is frequently claimed that not only is camphor lost during the preparation of the liniment with heat, but that even greater losses occur in dispensing the finished product. To test these claims a solution was made up strictly according to the U. S. P. proportions, using 12.5 gms. of camphor and 50 gms. of oil. After solution was effected the original 62.5 gms. weighed 62.4725 gms., a loss of only .0275 gms., or 0.04 per cent.

A portion of the liniment thus prepared was placed in a bottle, kept uncorked in a closet at room temperature (20° to 25° C.), and examined at intervals for camphor. The following results were obtained:

Original mixture	19.89%	camphor.
After 26 hours	19.89%	"
" 166 "	19.78%	"
" 362 "	19.69%	"

After standing uncorked for one day in a moderately warm place there was no loss of camphor. After seven days a loss of only 0.11 per cent. The very severe test of standing uncorked for fifteen days caused a loss of but 0.20 per cent. In the preceding tables we have classed as up to standard all samples containing 18 per cent. or more of camphor, an allowance of 10 per cent. variation from the standard, certainly a very generous allowance.

One hundred and fifty-eight samples were collected by the station, seventy-seven of which were less than 90 per cent. of U. S. P. strength. The analyses are given in Tables XXXII and XXXIII.

The selling price ranged from 10 to 25 cents for 2-ounce bottles, and from 20 to 35 cents for 4-ounce bottles.

The samples ranged in camphor from none at all to 26.5 per cent., with an average of 16.69 per cent. A summary follows:

41	samples	contained	from 20–26	per	cent.
40	"	"	" 18–20	"	"
23	"	"	" 16–18	"	"
25	"	"	" 12–16	"	"
15	"	"	" 9–12	"	"
10	"	"	" 5– 9	"	"
4	"	"	less than 5	"	"

The refractive indices in a number of samples were abnormal for cottonseed oil. The refractive index of cottonseed oil at 25° C. ranges from 1.4702 to 1.4722. The indices of the camphorated oil classed as up to standard ranged from 1.4672 to 1.4741, while those below standard ranged from 1.4668 to 1.4822. In the nine samples giving the abnormal refractive indices the Hübl iodine number was determined in both the original and decamphorated oils, the absorption period being four or sixteen hours. The results secured appear below.

No. 21683 consisted largely of cottonseed oil, but the high refractive index and iodine number indicated an impure oil. No. 21752 likewise consisted largely of an impure cottonseed oil. No. 21212 gave only a moderate Halphen reaction for cottonseed oil, and contained no sesame oil (Baudouin test). The free fatty acids in 100 gms. of sample were equivalent to 52 cc. $\frac{N}{10}$ KOH. For various reasons the data exclude corn, palm, olive and castor oils. A mixture of cottonseed oil and lard oil would refract as

ANALYSES OF SOLVENT OILS.

Station No.	Butyro Refractometer at 25° C.	Refractive Index at 25° C.	Hübl Iodine Number. Original Oil. 4 hrs.	Original Oil. 16 hrs.	Decamphorated Oil. 4 hrs.	Halphen Test.	Conclusions.
21683	73	1.4741	117.8	119.1	----	Yes	Impure cottonseed oil.
21752	72	1.4735	91.5	----	79.2	Yes	Impure cottonseed oil.
21212	62	1.4672	40.3	----	42.9	Yes	Cottonseed oil, and low refracting oil, probably lard oil.
21213	86.5	1.4822	38.4	----	43.9	Yes	Cottonseed oil, a mineral oil, and possibly linseed oil.
21741	62	1.4672	75.1	----	72.2	No	Olive oil.
21083	61.5	1.4668	73.7	----	77.0	No	Olive oil.
21082	62.5	1.4675	81.9	----	79.1	No	Olive oil.
21704	77.5	1.4768	101.4	101.6	98.6	Yes	Impure cottonseed oil.
21703	79	1.4777	158.0	161.8	150.1	No	Probably linseed oil.

this sample did, but the iodine number should be higher. The content of free fatty acids would tend to reduce this number and might bring it down to the number shown by the sample.

No. 21213 showed a very high refractive index and low iodine number. Saponification and extraction of the soap solution with ether gave a fluorescent solution, indicating the presence of a hydrocarbon (mineral) oil. Since hydrocarbon oils do not absorb iodine to any appreciable extent under the conditions of the Hübl method, the effect of its presence in the sample is to lower the iodine number. The high refractive index can only be accounted for by the presence of some high refracting oil like linseed oil.

Nos. 21741, 21083 and 21082 contained no cottonseed oil, and consisted chiefly of olive oil, the oil formerly required by the U. S. P. formula.

No. 21704 consisted of an impure cottonseed oil. No. 21703 contained no cottonseed oil; its high refractive index and iodine number indicated that it was probably largely linseed oil.

Dairy Commissioner's Samples.

It is the practice of the station, in order to save the expense of the triple samples required by the law, to take single samples of foods and drugs, analyze them, and report those found to be adulterated, misbranded, or below standard to the Dairy Commissioner. He in turn, or his deputy, takes second samples from

the stock of the dealers reported, and prosecutions are based on the analyses of these samples made by the station. A possible objection to this method is that if it be noised abroad that the station is examining a certain class of materials, the Dairy Commissioner is quite likely to find the samples he takes fully up to standard. On the other hand, while prosecutions are often

TABLE XXXIV.—CAMPHORATED OIL UP TO STANDARD* (DAIRY COMMISSIONER'S COMPARED WITH STATION'S SAMPLES).

Station No.	Dealer.	Dairy Commissioner.		Station.	
		Refractive Index at 25° C.	Camphor.	Refractive Index at 25° C.	Camphor.
2703	*Bridgeport:* Dupee's Pharmacy	1.4707	19.0	1.4705	0.0
2702	Wilma M. Bachman	1.4704	18.4	1.4707	6.5
2726	*Bristol:* Madden's Drug Store	1.4685	18.9	1.4697	13.8
2799	*Collinsville:* E. A. Hough	1.4704	19.7	1.4704	15.5
2667	*Hartford:* Pike's Drug Store	1.4697	20.1	1.4694	5.9
2666	P. J. Cavanaugh	1.4697	19.2	1.4704	3.9
2676	T. J. Blake, Jr.	1.4704	19.2	1.4700	14.8
2677	*New Britain:* Joseph H. Lutz	1.4704	20.0	1.4710	15.9
2747	*New Haven:* The 5c & 10c Drug Cabinet Co.	1.4704	21.1	......	...
2768	*Norwich:* John A. Morgan	1.4704	23.1	1.4723	15.3
2715	Wm. H. Nicholson	1.4697	23.0	1.4703	9.5
2759	*Putnam:* G. E. Dresser	1.4704	18.0	1.4717	14.3
2710	*Shelton:* Fred S. Sanford	1.4685	22.0	1.4707	13.3
2793	*So. Manchester:* Wickes & Quinn	1.4697	18.3	1.4697	14.1
2658	*Torrington:* E. F. Nolan	1.4704	27.0	1.4704	13.4
2660	Claxton's Pharmacy	1.4694	21.5	1.4697	9.5
2661	Jas. N. Banziger	1.4697	21.2	1.4700	14.4
2685	*Wallingford:* T. F. Collins	1.4704	19.9	1.4697	11.2
2684	D. J. Tucker	1.4704	18.2	1.4700	16.1
2674	*Willimantic:* J. J. Hickey & Co.	1.4697	21.2	1.4675	1.1

* Includes samples less than 10 per cent. below U. S. P. strength.

thus avoided, the real purpose of the law, namely, that the consumer shall be offered only pure foods and drugs, is in great measure accomplished.

The effect of this method of examination is shown very clearly in the examination of camphorated oil this year. At the instance of the station the Dairy Commissioner collected fifty samples of camphorated oil from druggists whom the station had reported as selling material below standard. Analyses of these samples showed that twenty of them now met the station's requirements, while thirty were still more than 10 per cent. below standard.

It will be observed from the table, where the two sets of samples are compared, that in the "up to standard" samples the average percentage of camphor rose from 11.0 to 20.4, while in the samples still below standard there was a slight increase from

TABLE XXXV.—CAMPHORATED OIL BELOW STANDARD (DAIRY COMMISSIONER'S COMPARED WITH STATION'S SAMPLES).

Sample No.	Dealer.	Dairy Commissioner.		Station.	
		Refractive Index at 25° C.	Camphor.	Refractive Index at 25° C.	Camphor.
2707	*Ansonia:* S. W. Smith & Co.	1.4704	16.5	1.4707	9.6
2711	*Branford:* John A. Morton	1.4704	13.5	1.4697	12.2
2701	*Bridgeport:* The Cyrus Pharmacy	1.4704	13.0	1.4700	13.1
2769	*Canaan:* John L. Thurlough	1.4707	11.9	1.4704	13.0
2761	*Danielson:* The Burroughs Drug Co.	1.4704	17.8	1.4720	15.9
2762	L. J. Morin	1.4710	17.6	1.4723	9.8
2665	*Hartford:* Rickman Bros.	1.4685	14.6	1.4697	16.0
2668	D. G. Stoughton & Co.	1.4697	11.2	1.4700	14.5
2664	D. W. Tracy	1.4697	9.7	1.4697	14.8
2725	*Jewett City:* L. V. L'Heureaux	1.4704	15.8	1.4704	15.8
2698	*Meriden:* V. W. Schmelzer	1.4704	12.3	1.4707	9.6
2696	*Middletown:* Bergquist Bros.	1.4710	16.5	1.4698	13.8
2693	H. N. Lincoln	1.4678	15.2	1.4672	14.8
2694	Henry Woodward	1.4710	13.1	1.4822	9.7
2765	*Moosup:* W. H. Sargent	1.4710	7.4	1.4723	7.6
2751	*New Britain:* Odell's Pharmacy	1.4717	9.2	1.4707	7.8
2739	*New Haven:* Mayer & Loeb*	1.4707	17.5	1.4700	17.3
2687	C. A. Lamb	1.4704	14.3	1.4700	13.0
2679	J. T. Hillhouse	1.4704	10.9	1.4697	10.5
2681	Conway & Currier	1.4697	10.1	1.4710	11.2
2669	James A. Notkin	1.4700	8.6	1.4700	8.9
2766	*Norwich:* W. J. Galvin & Co.	1.4717	17.0	1.4735	10.3
2691	Engler & Smith	1.4707	14.9	------	---
2760	*Putnam:* Simon Farley	1.4704	10.0	1.4717	12.0
2734	*Rockville:* E. F. Wilson	1.4704	17.0	1.4704	16.3
2733	*Stafford Springs:* A. C. Eaton	1.4704	7.8	1.4700	12.0
2714	*Stamford:* Parker & Ward	1.4704	9.9	1.4710	11.4
2662	*Waterbury:* McCarthy Pharmacy	1.4700	13.2	1.4704	14.9
2672	*Willimantic:* Leonard's Pharmacy	1.4700	9.7	1.4668	2.9
2757	*Windsor Locks:* H. N. Lebell	1.4704	16.1	------	---

* Arthur's Camphorated Oil. The Five and Ten Cent Drug Cabinet Co., New Haven.

12.1 to 12.9 per cent. The improvement in certain individual samples was very marked; for instance, one that contained no camphor at all rose to 19 per cent., four others originally containing less than 7 per cent., in the second samples showed from 18 to 21 per cent. On the other hand, twenty-two samples showed

very little or no improvement. It is to be observed, also, that in every case but one, No. 2693, the oil used was cottonseed; samples 2674 and 2672, the station samples being made with olive oil, contained cottonseed oil only; sample 2694, the station sample containing mineral oil and a high refracting oil, contained only cottonseed oil as required. On the whole the improvement is quite satisfactory, and while by our method of taking samples twenty druggists have escaped the chance of prosecution, our inspection has at least resulted in supplying consumers with twenty more stores where they can purchase standard camphorated oil.

CASTOR OIL.

(*Oleum Ricini.*)

The Pharmacopœia describes castor oil as "a fixed oil expressed from the seed of *Ricinus communis* Linné." "A pale

TABLE XXXVI.—CASTOR OIL NOT FOUND ADULTERATED.

Station No.	Dealer.	Price per bottle, cents.	Specific Gravity at 25° C.	Refractive Index at 25° C.	Iodine Absorption No.	Solubility in Alcohol
21105	*Greenwich:* H. C. Boswell	20	.9584	1.4768	87	Complete
21062	*Meriden:* N. P. Forcier	10	.9594	1.4765	87	Complete
21064	H. T. Graeber	10	.9554	1.4762	88	Complete
21063	West End Pharmacy	10	.9574	1.4762	88	Complete
21074	*New Britain:* J. P. Connors	15	.9564	1.4765	87	Complete
21075	Geo. M. Ladd	10	.9531	1.4765	88	Complete
21073	S. P. Storrs	10	.9544	1.4762	87	Complete
21120	*New Haven:* J. J. Alling	10	.9534	1.4768	89.6	Complete
21639	*Mayer & Loeb	10	.9274	1.4768	84	Complete
21121	C. B. Storer	10	.9531	1.4765	88	Complete
21119	Frank Thompson	10	.9534	1.4771	88	Complete
20936	E. Wadewitz	15	.9534	1.4765	87	Complete
21040	*South Norwalk:* F. H. Baxter	15	.9594	1.4765	87	Complete
21029	*Stamford:* †Cash Premium Store	10	.9594	1.4765	88	Complete
21021	A. L. Embree	15	.9594	1.4765	87	Complete
21022	W. H. Jones	15	.9594	1.4765	86	Complete
20987	*Waterbury:* John B. Ebbs	10	.9584	1.4762	87	Complete
20993	Ideal Pharmacy	15	.9594	1.4768	86	Complete
20985	Picarelli's Pharmacy	25	.9554	1.4765	87	Complete
20986	Waterbury Drug Co.	15	.9594	1.4765	87	Complete
21085	*Willimantic:* Chas. De Villiers	10	.9554	1.4765	88	Complete
21084	Fred Rogers	10	.9554	1.4777	86	Complete

* Arthur's Castor Oil. The Five and Ten Cent Drug Cabinet Co., New Haven.

† Howland's Pure Cold Pressed Castor Oil. Vernon Mfg. Co., Mount Vernon, N. Y.

yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor, and a bland, afterwards acrid and generally offensive taste. Specific gravity: 0.945 to 0.965 at 25° C." It should be soluble in three times its volume of 92.5 per cent. alcohol, and its iodine value should be not less than 86 nor more than 89 after eight hours' absorption. The refractive index at 25° C. should be between 1.4758 and 1.4771.

Twenty-two samples were examined, all but two of which bore simply the druggist's label.

With the exception of Arthur's Castor Oil, **21639**, all the samples met the U. S. P. requirements. This sample was low in specific gravity and in iodine absorption power, but no foreign oil was detected in it. The other samples ranged in specific gravity from .9531 to .9594, refractive index from 1.4672 to 1.4777, and iodine number from 86 to 89.6.

CATARRH POWDERS.

These powders are very commonly used, not only to mitigate the disease specified, but also as a means of securing cocaine by those addicted to that drug, some of them containing nearly 4 per cent. of cocaine hydrochlorid. The sale of any cocaine preparation is illegal in this State except on a physician's prescription.

Six samples were examined last year for the Dairy Commissioner, but no details were supplied in our last report. These are now included, together with seven additional samples collected this year, as follows:

2121. *Anglo-American Med. Co.'s Catarrhal Powder* (contains 10 gr. cocaine to the ounce or 2.5 per cent.), Anglo-American Med. Co., Chicago, Ill., Toronto, Can. (Formerly sold as Dr. Agnew's Catarrhal Powder.) Sold by W. H. Crowell, New Britain; price, 50 cents per bottle. *It contained 0.88 per cent. cocaine.*

21047. *Dr. Birney's Catarrh Pulver,* Birney Catarrhal Powder Co., Chicago, New York (Sodium bicarbonate, sodium benzoate, eucalyptol and menthol, combined with 1⅞ per cent. cocaine hydrochlorate). Sold by Graeber's Pharmacy, Meriden; price, 50 cents per package. *It contains 1.10 per cent. cocaine hydrochlorid.*

2097. *Dr. Coles Catarrh Cure,* The Cole Medicine Co., Brooklyn, N. Y. Sold by John F. Berger, Ansonia; price, 25 cents per bottle. *It contained 3.77 per cent. cocaine hydrochlorid.* **2095,** same brand, sold by Waterbury Drug Co., Waterbury; same price. *It contained 3.08 per cent. cocaine hydrochlorid.* **2100,** same brand, sold by S. H. Williams & Co., New Haven; same price. *It contained 3.22 per cent. cocaine hydrochlorid.* These three samples are also illegally labeled a "cure."

2093. *Gray's Catarrh Powder* (eight grains cocaine hydrochlorid to the ounce), The Gray Medicine Co., New York. Sold by Edward Toucey, Bridgeport; price, 25 cents per bottle. *It contained 1.66 per cent. cocaine hydrochlorid.* **2096,** same brand, sold by Apothecaries Hall Co., Waterbury; price, 50 cents per bottle. *It contained 1.68 per cent. cocaine hydrochlorid.* **3035** and **20978,** same brand, sold by the same druggists, respectively, a few months later (guaranteed to contain no harmful drugs). No cocaine was present in either sample.

20977. *Dr. Marshall's Aromatic Catarrh and Headache Snuff* (It contains no cocaine, morphine nor other injurious drugs), F. C. Keith, Cleveland, O. Sold by Callender & Haggerty, Waterbury; price, 25 cents per bottle. No cocaine was present.

20976. *Dr. Sage's Catarrh Remedy,* World's Dispensary Medical Asso., Buffalo, N. Y. Sold by Buckingham Pharmacy Co., Waterbury; price, 50 cents per package. No cocaine was present.

21027. *Dr. R. Schiffmann's Asthmador* (Perfectly Harmless), R. Schiffmann, St. Paul, Minn. Sold by Borg Bros. & Co., Stamford; price, 50 cents per package. No cocaine was present.

21046. *Asthma Powder* used by Inhalation, prepared for Whitman Chemical Co., Boston, Mass. Sold by A. M. Campbell, Meriden; price, 25 cents per package. No cocaine was present.

Seven of the thirteen samples contained from 0.99 to 3.77 per cent. cocaine hydrochlorid. Five of these bore a statement on the label that they contained cocaine and there is no possible legitimate excuse for their sale. It is understood by the station that Dr. Coles Catarrh Cure has been withdrawn from sale in this State. The formula for Gray's Catarrh Powder has evidently been changed, as the later samples contained no cocaine. It will be interesting to note whether this now cocaineless catarrh powder continues to maintain its former popularity.

The sale of the following catarrh powders is shown by our analysis to be illegal except on a physician's prescription:

Anglo-American Med. Co.'s Catarrhal Powder.
Dr. Birney's Catarrh Pulver.
Dr. Coles Catarrh Cure.
Gray's Catarrh Powder (old formula).

"Bing."

The search of a boy prisoner arrested in New Haven revealed an empty bottle, to the contents of which the prisoner attributed his downfall. The drug store of George D. Farovid (City Drug Store), New Haven, where the material had been purchased, was visited by representatives of County Health Officer C. E. Hoadley and of the Dairy Commissioner and six samples of the powder, called *"Bing,"* were bought and submitted to the station for analysis. These contained 2.79, 2.77, 2.81, 1.95, 2.79 and 2.81 per cent. of cocaine, respectively.

Two other suspicious samples were submitted by Mr. Hoadley, **22164,** *Menthol Snuff,* sold by a New Haven druggist, and **22165,** an unnamed white powder bought in a New Haven cheap lodging-house. The former consisted largely of menthol, and contained no morphine and only a trace of cocaine. The latter contained no cocaine, but responded to positive tests for morphine.

COD LIVER OIL.

(*Oleum Morrhuae.*)

The U. S. Pharmacopœia defines cod liver oil as "a fixed oil obtained from the fresh livers of *Gadus morrhua* Linné, and of other species of *Gadus.*" "A pale yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor and a bland, fishy taste."

Its specific gravity should be between 0.918 and 0.922 at 25° C. It should be "only very slightly acid to blue litmus paper which has been previously moistened with alcohol (limit of *free fatty acids*)." Its iodine absorption value, after standing four hours, should not be less than 140 nor more than 150.

The Pharmacopœia also prescribes certain tests for detecting the presence of seal oil and other fish oils, but in our experience these tests give no satisfactory results. Tolman* made an extensive study of American cod liver oils of known purity and

* Jour. Amer. Chem. Soc., 1906, *28*, 388.

Table XXXVII—Cod Liver Oil.

Station No.	Manufacturer or Dealer.	Place of Sampling.	Specific gravity at 25° C.	Refractive Index at 25° C.	Iodine No. Hübl.	Reichert-Meissl No.	Free Fatty Acids as Oleic.
							%
21136	Cod Liver Oil	*Bridgeport:* J. N. McNamara	.923	1.4765	159.0	0.4	0.65
20948	" " "	*Bethel:* Chas. J. English	.921	1.4771	158.5	0.2	0.48
21286	" " " Squibb. E. R. Squibb & Sons, New York and Brooklyn	*New Haven:* Le Grand Cannon	.921	1.4768	152.8	0.3	0.47
21237	" " "	*Norwich:* Woodworth's Drug Store	.921	1.4759	152.7	0.9	0.49
21275	" " "	*Hartford:* W. J. Galvin	.923	1.4765	151.9	0.6	0.52
21350	" " "	*Hartford:* L. H. Tracy	.922	1.4759	151.6	0.5	0.57
20990	Pure Norwegian Cod Liver Oil	*Waterbury:* The McCarthy Pharmacy	.922	1.4765	151.4	0.6	0.90
24230	Cod Liver Oil	*New London:* Nichols & Harris	.922	1.4762	151.2	0.8	0.51
21348	" " "	*Hartford:* L. G. Harris	.923	1.4759	151.1	0.8	0.69
21366	" " "	*Naugatuck:* S. Gladding, Jr.	.922	1.4765	151.0	0.3	0.63
21112	" " "	*New Haven:* J. H. Levy	.921	1.4762	150.7	0.6	0.50
21334	" " "	*Ansonia:* W. H. Collins	.923	1.4768	150.5	0.4	0.81
21347	" " "	*Hartford:* J. P. Barnett	.922	1.4759	151.3	0.3	0.53
21151	" " "	*Bridgeport:* W. L. Watson & Co.	.922	1.4765	150.2	0.2	0.53
20945	" " "	*New Milford:* Albert Evitts	.921	1.4771	150.1	1.2	0.93
21080	" " "	*New Britain:* City Drug Store	.922	1.4771	150.0	0.6	2.02
21274	Norway Cod Liver Oil	*Hartford:* J. K. Williams	.922	1.4759	150.0	0.2	0.56
21309	Cod Liver Oil	*New Haven:* J. M. Jacobs	.922	1.4765	149.9	0.4	0.58
21088	" " "	*Willimantic:* City Drug Store	.921	1.4765	149.7	1.1	0.65
20902	" " "	*Waterbury:* Myles A. McCarthy	.921	1.4765	149.6	0.6	0.48
21006	" " "	*Greenwich:* Greenwich Drug Store	.922	1.4765	149.6	0.4	0.46
21210	" " "	*Middletown:* Hartman Drug Co.	.923	1.4765	149.5	0.9	0.63
21310	" " "	*New Haven:* Oak Pharmacy	.923	1.4765	149.2	0.8	0.72

TABLE XXXVII—COD LIVER OIL—*Continued.*

Station No.	Manufacturer or Dealer.	Place of Sampling.	Specific gravity at 25° C.	Refractive Index at 25° C.	Iodine No. Hübl.	Reichert-Meissl No.	Free Fatty Acids as Oleic.
							%
20983	Cod Liver Oil	*Waterbury:* A. T. Webster	.921	1.4765	149.1	0.3	0.55
21395	" " "	*Litchfield:* The Wheeler Pharmacy Co.	.923	1.4765	149.0	0.4	1.26
21199	Pure Norwegian Cod Liver Oil	*Middletown:* Bergquist Bros.	.922	1.4759	148.7	0.2	0.69
21059	Cod Liver Oil	*Meriden:* V. W. Schmelzer	.922	1.4765	148.2	0.5	0.66
21061	" " "	*Meriden:* A. M. Campbell	.921	1.4762	148.2	0.5	0.72
21168	" " "	*Danbury:* Shepard's Pharmacy	.922	1.4765	148.2	0.8	0.57
21320	" " "	*Derby:* Henry B. Peck	.921	1.4759	147.9	0.4	0.60
21252	" " "	*Norwich:* Steimer's Pharmacy	.922	1.4762	147.7	0.7	0.89
21311	" " "	*New Haven:* Ferraioli & Boccagna	.923	1.4968	147.6	0.7	0.75
21024	Genuine Norwegian Cod Liver Oil	*Stamford:* Borg Bros. and Co.	.921	1.4959	147.6	0.3	0.93
21081	Cod Liver Oil	*New Britain:* Chas. Scherp	.921	1.4765	147.3	0.6	0.75
21090	" " "	*Willimantic:* Saml. Chesbro	.922	1.4765	147.1	1.1	0.80
21289	" " "	*New Haven:* E. Healy's Pharmacy	.923	1.5765	147.0	1.4	0.81
21313	" " "	*New Haven:* S. & R. Negbaur	.923	1.4765	146.4	0.6	0.66
21023	" " "	*Stamford:* J. K. Lawrence	.923	1.4765	146.4	0.1	1.20
21113	" " "	*New Haven:* J. Linde & Son	.921	1.4765	146.2	0.6	0.61
21321	" " "	*Derby:* Kelty's City Pharmacy	.921	1.4762	145.7	0.2	0.58
21110	" " "	*New Haven:* J. A. Notkin	.920	1.4762	145.5	1.2	0.54
21287	" " "	*New Haven:* H. J. Sperry	.922	1.4756	145.4	0.9	0.64
20984	" " "	*Waterbury:* Nugent's Pharmacy	.922	1.4765	145.3	0.8	0.73
21036	" " "	*Norwalk:* W. C. Baur	.921	1.4759	145.0	0.4	0.68
21325	" " "	*Shelton:* Apothecaries Hall	.923	1.4768	145.0	0.6	1.20
21156	Pure Norwegian Cod Liver Oil	*Bridgeport:* Wilma H. Bachman	.921	1.4759	144.9	0.7	0.43
21154	Cod Liver Oil	*Bridgeport:* W. H. Gardner	.922	1.4765	144.5	0.9	0.86

TABLE XXXVII—COD LIVER OIL—*Concluded.*

Station No.	Manufacturer or Dealer.	Place of Sampling.	Specific gravity at 25° C.	Refractive Index at 25° C.	Iodine No. (Hübl.)	Reichert-Meissl No.	Free Fatty acid as Oleic.
21349	Cod Liver Oil	*Hartford:* Brown's Drug Store	.923	1.4765	144.4	0.2	0.63
20937	" " "	*New Haven:* W. A. Spalding	.920	1.4765	144.1	0.4	0.38
21031	" " "	*Stamford:* Marron's Pharmacy	.920	1.4759	144.0	0.5	0.63
21114	" " "	*New Haven:* E. Wadewitz	.920	1.4759	143.5	0.1	0.94
21253	" " "	*Norwich:* C. C. Treat	.923	1.4759	143.0	0.8	1.15
21176	Pure Norwegian Cod Liver Oil	*Danbury:* Kinner & Benjamin	.921	1.4759	142.2	0.3	0.49
20956	Cod Liver Oil	*Torrington:* C. H. Dougal	.921	1.4753	142.2	0.1	1.32
21177	" " "	*Danbury:* Wheeler's Drug Store	.921	1.4750	141.8	0.6	0.74
21288	" " "	*New Haven:* Hull's Corner Drug Store	.921	1.4753	141.7	0.2	0.77
21131	Genuine Medicinal Cod Liver Oil	*Bridgeport:* F. B. Brill	.920	1.4750	141.5	0.1	0.62
21152	Cod Liver Oil	*Bridgeport:* J. A. Leverty & Bro.	.920	1.4753	141.5	1.0	0.61
20954	" " "	*Torrington:* Apothecaries Hall	.921	1.4753	141.4	0.9	0.88
21153	Pure Cod Liver Oil	*Bridgeport:* Brinkerhoff Bros.	.920	1.4750	141.1	0.7	0.80
20946	Cod Liver Oil	*New Milford:* W. N. Noble	.930	1.4771	141.1	1.5	2.78
20947	" " "	*Bethel:* P. J. Garvin	.921	1.4771	140.4	0.4	0.75
21135	" " "	*Bridgeport:* W. J. Nichols	.923	1.4756	140.1	0.9	0.68
20953	" " "	*Torrington:* South End Pharmacy	.921	1.4753	139.8	0.3	0.76
21060	" " "	*Meriden:* F. M. Kibbe & Co.	.920	1.4753	138.3	0.9	0.64
21042	" " "	*South Norwalk:* Plaisted's Drug Store	.920	1.4750	137.6	0.4	0.82
21111	" " "	*New Haven:* Alling's Drug Store	.921	1.4753	135.5	0.6	1.08
20955	" " "	*Torrington:* Migeon Ave. Pharmacy	.933	1.4771	119.6	2.9	3.22
21231	" " "	*New London:* McBride's Pharmacy	.926	1.4789	113.4	2.2	8.58
21333	" " "	*Ansonia:* Ansonia Drug Store	.920	1.4796	96.2	8.1	8.20

concluded, with the exception of the specific gravity limits, "that the standards and tests of the U. S. Pharmacopœia, which are satisfactory for Norwegian oils are not applicable to the American oils, which are liable to show more variation, and the color tests as laid down are not characteristic of cod liver oil but only of fish liver oils. Further, the nitric acid test is liable to give misleading results with many pure cod liver oils of American origin."

Recognizing the valuelessness of these tests, they were abandoned early in our investigation, and our examination was confined to a determination of specific gravity, refractive index, Hübl iodine number, Reichert-Meissl number and the free fatty acids. The methods of analysis used were those given in Bull. 107 (revised) U. S. Department of Agriculture, Bureau of Chem., pp. 129-142. The only deviation from the official methods was in the case of iodine number, where, in those samples not falling within the limits of the U. S. P. standard, new determinations were made strictly according to the U. S. P. requirement of four hours. The result of this comparison will be referred to later.

Seventy samples were analyzed. In only one case was a distinguishing brand name used, all the others bearing the druggists' label. Six were labeled "Norwegian," the others simply "cod liver oil."

The following tabulation contain a summary of our results, excluding four distinctly inferior samples, compared with those secured by Tolman with twenty pure American oils.

	Tolman (20 analyses).			Connecticut (66 analyses).		
	Max.	Min.	Ave.	Max.	Min.	Ave.
Specific gravity at 25° C.	0.9220	0.9174	0.9200	0.9230	0.9200	0.9216
Index of refraction at 25° C.	1.4779	1.4748	1.4767	1.4771	1.4750	1.4761
Iodine number	172.6	135.4	152.4	159.0	135.5	146.8
Reichert-Meissl number	------	------	------	1.4	0.1	0.6
Free fatty acids	------	------	------	2.02	0.38	0.74

The two sets of analyses are shown to agree remarkably well, the widest variation being in the maximum iodine number, due to a single abnormal sample included in Tolman's results. The U. S. P. limits for specific gravity are found to be entirely reasonable, but our iodine numbers confirm Tolman's conclusion that

"the range of iodine number of 140-150 as given in the Pharmacopœia seems to be exceedingly narrow." In seven samples the iodine number was determined with both three- and four-hour periods of absorption with the following results:

No.	3 hrs.	4 hrs.
21152	138.3	141.5
21153	136.7	141.1
21060	136.9	138.3
21042	135.5	137.6
21111	138.5	135.5
21231	113.4	113.4
21333	100.6	96.2
Ave.	128.6	129.1

The differences are insignificant in all cases, the longer period naturally as a rule giving slightly higher iodine values. "The higher the iodine value, the less oxidation can have taken place, and if the medicinal properties be valued by the amount of unsaturated fatty acids, then the higher iodine value the better the oil."* The same authority claims that for the valuation of medicinal cod liver oil, the acid value, iodine value, and the Reichert-Meissl value furnish the most valuable indications. He claims that the best steam cod liver oils contain from 0.3 to 1.5 per cent. of free fatty acids (calculated as oleic acid), and that the Reichert-Meissl value should not exceed 0.5, a higher number indicating that the livers employed had not been fresh. The following tabulation shows the acid value and free fatty acids (as oleic) as reported by Lewkowitsch:

	Color.	Acid Value.	Free Fatty Acids.
Raw medicinal oil	Pale	7.38	3.79
" " "	Somewhat darker	7.35	3.87
" " "	Darkest	7.72	3.96
Pale oil, obtained from livers by decay	Pale	21.20	10.90
Brown oil, obtained from livers by decay	Brown	54.40	28.00
Medicinal oil	Yellow	----	0.36
Scotch cod oil	Brown	----	9.73
Newfoundland cod oil	Red-brown	----	23.31
Medicinal oils	------	----	0.34—0.60

In our examination the acid value was not determined, but this can be calculated with approximate accuracy from the free

* Lewkowitsch, Chem. Tech. and Anal. Oils, Fats and Waxes, 1904, ii, 668.

fatty acids (as oleic), by multiplying the latter by 1.9893.* Applying this factor in our samples, the free fatty acids ranged from 0.38 to 2.02, and acid values from 0.76 to 4.02. Only five samples exceeded Lewkowitsch's limit for free fatty acids; these contained 2.02, 2.78, 3.22, 8.58 and 8.20.

The Reichert-Meissl numbers ranged from 0.1 to 1.4, thirty-eight exceeding 0.5; in only three samples were these numbers considered objectionably high, where value of 2.2, 2.9 and 8.1 were obtained.

Summarizing our examination, we found that sixty-six samples ranged from .920 to .923 specific gravity, from 1.4750 to 1.4771 refractive index, from 135.5 to 159.0 iodine number, from 0.1 to 1.4 Reichert-Meissl number, and from 0.38 to 1.32 free fatty acids; these samples ranged in color from a pale yellow to a light yellowish-brown, except **20945** and **20956**, which were somewhat off color. While they doubtless varied considerably in quality, they all satisfied acceptably the standard for pure cod liver oil.

In four samples, however, we found considerable variations from the standards, and while we cannot class them as adulterated, they were certainly of inferior quality, and, with the exception of one constant in one sample, at variance with the U. S. P. requirements. These are summarized below:

SAMPLES BELOW STANDARD.

Station No.	Dealer.	Color.	Specific Gravity at 25° C.	Refractive Index at 25° C.	Iodine No.	Reichert-Meissl No.	Free Fatty Acids.
20946	W. N. Noble	Brownish	0.930	1.4771	141.1	1.5	2.78
20955	Migeon Ave. Pharmacy	Brown-red	0.933	1.4771	119.6	2.9	3.22
21231	McBride's Pharmacy	"	0.926	1.4789	113.4	2.2	8.58
21333	Ansonia Drug Store	"	0.930	1.4796	96.2	8.1	8.20

All of these samples showed high specific gravity, high Reichert-Meissl numbers, high free fatty acids, all but the first low iodine numbers, and the last two high indices of refraction; they were all also much off color. No certain indication of the presence of foreign oils was shown in any case, although **21231** and **21333** were so viscid that they could not be pipetted. The high

* Lewkowitsch, i, 279.

free fatty acids, and Reichert-Meissl numbers in these two samples indicated that badly decomposed livers had been used in the manufacture of the oils, and the low iodine numbers that the stearine had been very incompletely removed.

Analytical Note:—Mr. Bailey in his work on the saponification of the oils observed that upon the addition of about ten drops of strong sodium hydroxid to about 5 cc. of oil in a test tube more or less pronounced color changes took place. As a rule the oils became orange yellow, changing in some cases to a rather dark brown. Such oils produced a soap solution varying in color from light yellow to dark brown but not opaque. Between these two colors so many shades occurred as to make any distinction difficult. Other samples, however, produced with soda a very dark solution almost at once and gave on saponification a very dark soap solution which was opaque. It was observed that the standard high-grade oils gave the lighter colored soap solutions. Six samples, **21395**, **20954**, **20946**, **20955**, **21231** and **21333** gave the dark, opaque solutions; it will be noted that four of these are included in our "below standard" table, where other variations from the standards indicated their marked inferiority.

COCA WINE.

(*Vinum Cocae.*)

The Pharmacopœia requires that Coca Wine shall be made by the following formula:

65 cc. fluidextract of coca.
75 cc. alcohol.
65 gms. sugar.
Red wine, to make 1,000 cc.

Fluidextract of coca should contain 0.5 gm. of the ether-soluble alkaloids of coca per 100 cc., so that 1,000 cc. of coca wine should contain 0.325 gm. of these alkaloids.

Under the Connecticut law cocaine, its salts, and preparations containing the same, can be sold to the general public only on a physician's prescription, and even then under certain limitations. All of the samples herewith reported were bought in the open market without a physician's prescription, and without the seller being informed that the samples were bought for this station. A large number of the druggists visited refused to sell coca wine to the station's representative, and there is no question as to the trade's knowledge of the restrictions covering its sale. The amount of the alkaloid contained in coca wine is small, but that makes its use none the less insidious and dangerous.

TABLE XXXVIII.—COCA WINE.

Station No.	Brand.	Dealer.	Price per bottle, cts.	Specific gravity at 15.6° C.	Alcohol. By weight.	Alcohol. By volume.	Extract.	Polarization at 24.0° C. Direct.	Polarization at 24.0° C. After Inversion.
21087	Geo. L. Claflin & Co., Providence, R. I., Coca Wine	*Willimantic:* Chas. deVillers	75	1.04701	19.48	25.75	19.94	−1.7	−2.20
21323	The Maltine Mfg. Co., New York. Maltine with Coca Wine	*Derby:* Henry B. Peck	50	1.11007	12.43	17.35	36.83	+16.6	+16.72
20928	Mariani & Co., New York. Vin Mariani	*New Haven:* Mark N. Sullivan	100	1.01445	13.90	17.75	9.34	+0.4	−1.21
20926	Theodore Metcalf Co., Boston. Metcalf's Coca Wine	*New Haven:* J. A. Caryl	90	1.04786	15.56	20.50	18.76	−5.2	−5.94
21070	Reed & Carnrick, New York. Carnrick's Coca Muscatel	*New Britain:* J. R. Halloran	75	1.03609	15.35	20.05	15.55	−0.4	−0.44
21332	Druggist's label	*Ansonia:* The Bristol Drug Co.	50	1.02133	19.19	24.70	12.95	+0.7	−5.06
21157	" "	*Bridgeport:* Wilma M. Bachman	50	1.03405	14.12	18.35	14.59	+5.5	−4.07
21048	" "	*Meriden:* F. M. Kibbe & Co.	45	0.99962	17.81	21.80	6.56	−0.8	−0.88
21049	" "	*Meriden:* Meriden House Drug Store	35	1.08647	15.92	21.75	29.25	−0.4	−0.44
20924	" "	*New Haven:* G. H. Bishop	50	1.06825	12.83	17.25	23.25	−5.4	−5.72
20927	" "	*New Haven:* James T. Eagny	40	1.06516	17.65	23.60	24.12	−2.3	−5.94
20929	" "	*New Haven:* James A. Notkin	25	1.03548	18.06	23.55	16.33	−1.7	−6.44
21305	" "	*New Haven:* Oak Pharmacy	45	1.03328	15.40	20.05	14.83	+0.8	+0.88
21235	" "	*New London:* McBride's Pharmacy	75	1.03749	15.43	20.10	15.94	−2.8	−3.96
21243	" "	*Norwich:* Herrick Pharmacy	90	1.07715	17.64	23.85	27.35	−2.0	−2.42
20982	" "	*Waterbury:* H. W. Lake Drug Co.	50	1.03378	18.86	24.55	16.15	−0.7	−5.28
21089	" "	*Willimantic:* Samuel Chesbro	50	1.01942	16.48	21.00	11.47	−2.6	−2.86
21086	" "	*Willimantic:* Leonard's Pharmacy	25	1.05325	12.72	16.90	19.23	−3.8	−4.29

The determination of cocaine in this material presents considerable difficulty, and while physiological and chemical tests gave indications of its presence in many of the samples, the small amount of the wine at our disposal made the certain identification of the cocaine difficult and in some cases impossible. For this reason no cocaine results are reported in the tables.

Practically the sale of these wines is illegal in every case. If a wine contains no cocaine its sale as coca wine is illegal, an essential ingredient being absent; if it does contain cocaine its sale is illegal for the reasons referred to above.

The following brands contained on the label information as to the presence of cocaine and there is no possible excuse for their sale without a physician's prescription:

21323. *Maltine with Coca Wine.* "Each fluidounce contains Erythroxylon Coca, 30 grains."

20926. *Metcalf's Coca Wine.* "From Fresh Coca Leaves."

21070. *Carnrick's Coca Muscatel.* "Each fluidounce contains repercolated extract of coca leaves, 1 drachm."

The sample of *Vin Mariani*, **20928**, was labeled as follows: "Vin Mariani under this label is guaranteed free from cocaine." This preparation in past years has contained cocaine, but it would appear from their statement, which was confirmed by our tests, that cocaine is no longer present. While this fact would render its sale legal, it would also seem that by the removal of the cocaine, whatever virtues the preparation possessed other than those common to ordinary wine, were likewise removed.

The analytical data obtained in the examination of these samples is given in Table XXXVIII.

KOLA WINE.

21324. *Wampole's Kola Wine.* Sold by Fred S. Sanford, Shelton. Price, 50 cents per 8 ounces. The sample was sold on the agent's request for Coca Wine. The analysis was as follows:

Specific gravity at 15.6°	1.02178
Alcohol by weight	16.15
Alcohol by volume	20.75
Extract	12.01
Polarization at 24°, direct	—4.4
" " after inversion	—4.4

The smallness of the sample prevented a certain test for the presence of cocaine. Not being a U. S. P. preparation, the absence of a statement on the label of the percentage of alcohol renders the sale of this preparation illegal.

SOLUTION OF HYDROGEN DIOXIDE.

(*Aqua Hydrogenii Dioxidi.*)

The U. S. Pharmacopœia defines this preparation as "a slightly acid, aqueous solution of Hydrogen Dioxide, which should contain, when freshly prepared, about 3 per cent., by weight, of absolute Hydrogen Dioxide, corresponding to about 10 volumes of available oxygen."

Among other requirements given in that work are the following:

"Upon removing the stopper from the bottle not more than a slight pressure should be observed."

"If to 25 cc. of the Solution, 5 cc. of tenth-normal potassium hydroxide V. S. be added, and the mixture be evaporated to about 10 cc., and 3 drops of phenolphthalein T. S. be added, not less than 2.5 cc. of tenth-normal sulphuric acid V. S. should be required to discharge the red color of the solution after continued boiling (limit of *free acids.*)"

"If 20 cc. of the Solution be evaporated to dryness upon a water-bath, and the drying completed at 120° C. (248° F.), not more than 0.03 gm. of solid residue should remain (limit of *total solids*)."

Thirty-two samples of hydrogen dioxide, or, as it is more commonly called, hydrogen peroxide, were examined. In addition to the U. S. P. tests given above, the actual amount of hydrogen dioxide was determined, and an examination was made as to the nature of the preservative used, and the source of the acidity. The results of this examination are shown in Tables XXXIX and XL.

The samples were bought in various sized containers, ranging from one-quarter of a pound to a pound, and costing from 5 to 75 cents. One-fourth pound samples varied in cost from 5 to 35 cents, one-half pound samples from 17 to 50 cents, and pound packages from 50 to 75 cents, extremely wide variations, and, as will be shown later, but little dependent upon the quality of the product.

Twenty-one samples were either guaranteed 3 per cent. H_2O_2 and 10 volumes of available oxygen, or were marked U. S. P., which indirectly guarantees the same strength. One sample was guaranteed 12 volumes of available oxygen and two 15 vol-

Table XXXIX.—Hydrogen Dioxide (Hydrogen Peroxide).

Station No.	Manufacturer or Distributor.	Dealer.	Price of Sample.	Weight of Sample.	Guaranty. Hydrogen Dioxide.	Guaranty. Available Oxygen.	Guaranty. Acetanilid per fl. oz.
			cts.	lb.	%	vol.	gr.
23059	A. D. S. Peroxide of Hydrogen. American Druggists' Syndicate, N. Y.	*So. Norwalk:* Platner & Bradley	25	1/2	-	--	1/8
23014	Hydrogen Peroxide. Albany Chemical Co., Albany, N. Y.	*Bridgeport:* Edward Toucey	20	1/4	3	10	1/8
23264	" " " " " " "	*Middletown:* Buell & Blatchley	35	1/8	3	10	1/8
23291	" " Apothecaries Hall, Waterbury	*New Britain:* J. F. Burns	25	1/4	3	10	*
23142	" " " " "	*Waterbury:* Apothecaries Hall	35	1/8	3	10	*
23296	Arthur's Hydrogen Peroxide. The Arthur Chemical Co., New Haven	*New Haven:* F. Woolworth & Co.	10	1/4	3	10	3/16
23032	Peroxide of Hydrogen. Prep. for Carleton & Hovey Co., Boston	*Greenwich:* Wm. E. Finch	45	1/2	3	10	3/16
23321	Hydrogen Peroxide. Prep. for Conway & Currier, New Haven	*New Haven:* Conway & Currier	15	1/4	-	--	18/100
23092	Hydrogen Peroxide. Dist. by L. F. Curtis, Bridgeport	*Bridgeport:* L. F. Curtis	20	1/4	3	10	1/8
23273	Osborn's Hydrogen Peroxide. Custer Chemical Co., New York	*Meriden:* Meriden House Drug Store	15	1/4	3	10	3/16
23295	Hydrogen Peroxide. Dist. by Hull's Corner Drug Store, New Haven	*New Haven:* Hull's Corner Drug Store	17	1/2	3	10	1/8
23265	Hydrogen Peroxide. Hydrox Chemical Co., New York	*Middletown:* F. W. Woolworth & Co.	10	1/4	3	10	3/16
23244	" " " " " " "	*Norwich:* L. A. Bardol & Co.	5	1/4	3	10	3/16
23048	Peroxide of Hydrogen. Dist. by J. K. Lawrence, Stamford.	*Stamford:* J. K. Lawrence	40	1/2	3	10	--
23194	" " " Lehn & Fink, New York	*New London:* Moon's Pharmacy	25	1/4	-	--	18/100
23121	" " " " " " " "	*Danbury:* Barnum Pharmacy	30	1/4	-	--	18/100
23209	Hydrogen Peroxide. Mallinckrodt Chem. Works, St. Louis	*Norwich:* N. D. Sevin & Son	50	1	3	10	.0004

* Guaranteed preserved with boric acid.

TABLE XXXIX.—HYDROGEN DIOXIDE (HYDROGEN PEROXIDE)—*Continued.*

Station No.	Manufacturer or Distributor.	Dealer.	Price of Sample.	Weight of Sample.	Guaranty. Hydrogen Dioxide.	Guaranty. Available Oxygen.	Guaranty. Acetanilid per fl. oz.
			cts.	lb.	%	vol.	gr.
23307	Peroxide of Hydrogen. Charles Marchand, New York	*Hartford:* Sisson Drug Co.	75	1	§4.6	15	--
23313	" " " " " " "	*New Haven:* C. W. Whittlesey Co.	32	¼	§4.6	15	--
23272	" " " " " " "	*Meriden:* N. P. Forcier	35	¼	--	--	--
23219	Hydrogen Peroxide Merck.	*Norwich:* Lee & Osgood	25	¼	3	10	--
23310	Per-Man-Eo Peroxide of Hydrogen. Middletown Chem. Co., Middletown, N. Y.	*New Haven:* City Hall Drug Store	25	½	3	10	3/16
23266	†Hydrogen Peroxide. Prep. for John J. Murphy, Middletown	*Middletown:* John J. Murphy	25	¼	--	--	3/16
23046	Dioxogen. The Oakland Chemical Co., New York	*Stamford:* Borg Bros.	50	½	§3.7	12	--
23093	Hydrogen Peroxide. Parke, Davis & Co., Detroit	*Bridgeport:* Brinkerhoff Bros.	35	½	--	--	3/16
23312	Aqua Hydrogenii Dioxidi. Powers-Weightman-Rosengarten Co., Phila.	*New Haven:* C. G. Spalding	10	¼	3	10	.018%
23316	Aqua *Hydrogenii Dioxidi.* Powers-Weightman-Rosengarten Co., Phila.	*New Haven:* E. A. Gessner	15	¼	3	10	.018%
23315	Hydrogen Peroxide, Prep. for Shartenberg & Robinson Co., New Haven	*New Haven:* Shartenberg & Robinson Co.	10	¼	3	10	3/16
23314	Solution Hydrogen Peroxide, Squibb. E. R. Squibb & Sons, New York	*New Haven:* C. W. Whittlesey Co.	15	¼	--	10	--
23322	Ozo Hydrogen Peroxide. Henry Thayer & Co., Cambridge, Mass.	*New Haven:* 6 Corner Drug Store	25	¼	--	--	3/16
23311	‡Peroxide of Hydrogen. Prep. for E. L. Washburn Co., New Haven	*New Haven:* E. L. Washburn Co.	15	¼	3	10	3/16
23306	Hydrogen Peroxide. Williams & Carleton Co., Hartford	*Hartford:* M. M. Taylor	25	¼	3	10	3/16

† Bears same Serial No. as 23306. ‡ Bears same Serial No. as 23265 and 23244.

§ Calculated from guaranty of available oxygen (1% H_2O_2 = 3.29 volumes O).

Station No.	Brand.	Hydrogen dioxide. Kingzett method.	Hydrogen dioxide. Potassium permanganate method.	Available oxygen. Kingzett method.	Available oxygen. Potassium permanganate method.	Total Solids. Per cent.	Total Solids. Color.	‡Acidity 25cc. H_2O_2 =cc. $\frac{N}{10}$ K O H.	Acetanilid. Grs. per fl. oz.	Pressure on opening bottle.	Phosphoric acid (H_3PO_4). Per cent.
23059	A. D. S.	2.68	2.73	8.82	8.98	.053	White	0.95	none	slight	.015
23014	Albany	2.91	2.95	9.58	9.71	.068	Brownish	2.17	0.120	none	.015
23264	Albany	2.75	2.79	9.04	9.18	.106	Brownish	2.68	0.073	slight	.037
23291	Apothecaries Hall	3.13	3.05	10.30	10.03	.069	Brownish	2.92	0.144	slight	.019
23142	Apothecaries Hall	2.87	2.90	9.46	9.54	.089	Brownish	3.48	0.144	slight	.021
23296	Arthur	2.95	2.98	9.72	9.80	.128	Cream	2.47	0.168	none	.010
23032	Carleton & Hovey	1.89	1.91	6.22	6.28	.083	Cream	1.88	0.060	none	.015
23321	Conway & Currier	2.65	2.74	8.74	9.01	.366	Cream	9.25	0.144	slight	.227
23092	Curtis	2.92	3.00	9.60	9.87	.097	Brown	2.35	0.144	slight	.051
23273	Custer, (Osborn's)	2.82	2.88	9.30	9.48	.152	Cream	2.26	0.144	slight	.007
23295	Hull	2.98	3.01	9.80	9.90	.086	Brownish	2.19	0.168	slight	.022
23265	Hydrox	2.87	2.86	9.46	9.41	.120	Brown	4.12	0.168	slight	.046
23244	Hydrox	2.82	2.88	9.30	9.48	.067	Brown	2.95	*	none	.021
23048	Lawrence	1.77	1.74	5.82	5.72	.171	White	1.55	none	slight	.010
23194	Lehn & Fink	2.91	2.95	9.58	9.71	.134	Cream	2.87	†	none	.007
23121	Lehn & Fink	2.86	2.91	9.41	9.58	.157	Cream	3.05	0.135	slight	.003
23209	Mallinckrodt	2.89	2.92	9.52	9.61	.125	Brown	2.69	0.144	slight	.010
23307	Marchand	3.49	3.56	11.48	11.71	.068	Cream	5.13	none	none	.002
23313	Marchand	2.55	2.64	8.40	8.69	.095	Cream	6.05	none	none	.004
23272	Marchand	0.63	0.63	2.07	2.07	.126	Brown	9.20	none	none	.003
23219	Merck	2.47	2.52	8.12	8.29	.142	White	1.64	none	none	.001
23310	Middletown (Per-Man-Eo.)	3.06	3.13	10.08	10.30	.100	Brown	4.16	0.168	slight	.008
23266	Murphy	2.54	2.54	8.34	8.36	.130	Cream	3.10	0.073	none	.007
23046	Oakland (Dioxogen)	3.43	3.50	11.28	11.52	.042	Brownish	1.40	none	slight	.006
23093	Parke, Davis & Co.	2.91	2.96	9.58	9.74	.050	Brownish	2.50	0.204	slight	.019
23312	Powers-Weightman-Rosengarten	2.89	2.95	9.52	9.71	.122	Cream	2.17	0.048	slight	.007
23316	Powers-Weightman-Rosengarten	2.77	2.84	9.13	9.34	.124	White	1.00	0.072	slight	.002
23315	Shartenberg & Robinson	2.63	2.74	8.65	9.01	.102	Brownish	6.32	0.192	slight	.028
23314	Squibb	3.20	3.15	10.53	10.36	.089	Cream	3.68	none	none	.008
23322	Thayer (Ozo)	2.67	2.78	8.79	9.15	.109	Brownish	3.42	0.120	none	.038
[illegible]	Washburn	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

umes. The remaining eight samples bore no direct guaranty, but as they were sold under a U. S. P. name, they must be held to the strength therein laid down.

It is a recognized fact that hydrogen dioxide readily decomposes on keeping. To obviate this many manufacturers add small amounts of sulphuric or hydrochloric acid as a preservative; phosphoric acid also is sometimes used for the same reason. It appears, however, that at the present time the most popular preservative used is acetanilid, sometimes alone and sometimes with either sulphuric or hydrochloric acid. The Pharmacopœia recognizes the difficulty in keeping hydrogen dioxide up to standard strength, and permits the presence of a certain amount of acid, the acidity of 25 cc. of the solution not to exceed the equivalent of 2.5 cc. of tenth-normal potash. No recognition is given, however, to acetanilid, and as it is a foreign substance, its presence must be clearly stated on the label to render the sale of the material legal.

Twenty-three of the samples were guaranteed to contain acetanilid in quantities varying from three-sixteenths to one-sixth of a grain per fluidounce. In two samples boric acid was claimed as the preservative; in the remaining seven samples no preservative was indicated.

Methods of Analysis.

Hydrogen Dioxide:—The Pharmacopœia directs the use of the potassium permanganate method for the assay of hydrogen dioxide. This method has received considerable unfavorable criticism, chiefly because of the inaccuracies introduced by the presence of the usual preservative agents. To comply with the U. S. P. requirements this method has been used in the work here reported, as well as that suggested by Kingzett,* which appears to overcome the objection against the permanganate method. The slightly modified Kingzett method as used by us follows:

Measure 10 cc. of hydrogen dioxide into a 100 cc. flask, add 40 cc. sulphuric acid (sp. gr. 1.3) and make up to 100 cc. with water. Run 10 cc. of this solution into 10 cc. of 10 per cent. potassium iodide solution. Let stand for five minutes, add a few drops of starch solution (the addition of starch is rarely necessary) and titrate with tenth-normal sodium thiosulphate. One cc. of tenth-normal thiosulphate is equivalent to 0.001688 gm. of hydrogen dioxide, or 0.000794 gm. of available oxygen, or 0.556 cc. of available oxygen.

In the table comparative results by both methods are shown. The results for hydrogen dioxide vary from identity by both methods to 0.11

* Jour. Chem. Soc., 1880, *37*, 792.

per cent. higher by the permanganate method. The Kingzett method averages 2.73 per cent., the permanganate 2.77 per cent., showing that for practical purposes either method may be used, although it is believed that the results by the former are slightly more accurate.

Acidity:—It was found that the exact manipulation of the U. S. P. method gave very uncertain results, and we accordingly adopted the following modification, which proved very satisfactory:

Pipette 25 cc. of the solution into a small porcelain casserole, add 5 cc. tenth-normal potassium hydroxide, and evaporate to about 10 cc. Add two drops of phenolphthalein and about 4 cc. of tenth-normal sulphuric acid, boil for one minute, add tenth-normal potassium hydroxide to appearance of color, then one drop of tenth-normal sulphuric acid and boil for another minute. Repeat this operation until boiling of the neutral or slightly acid solution develops no further color. The volume of tenth-normal alkali minus the volume of tenth-normal acid gives the equivalent acidity of 25 cc. of the solution in terms of cubic centimeters of tenth-normal alkali.

Acetanilid:—*The method used was that suggested by* Waller,* as follows:

In a side-neck flask of 200 cc. capacity, place about 6 or 7 gms. of stick potash or soda, dissolve with 20 cc. of water and add 25-30 gms. of finely granulated zinc (this quantity is doubtless a very large excess, but lack of time prevented a certain demonstration of this statement). Add a measured amount of hydrogen dioxide (not over 50 cc.), and connect the flask on one side with a flask to supply steam, arranging the tube to deliver steam near the bottom of the solution; connect on the other side with a condenser, which should deliver into a Peligot bulb or similar contrivance whereby the distillate is immediately brought in contact with moderately strong hydrochloric acid.

Raise the heat slowly and when nearly half of the contents have distilled over, start to pass the steam through. The end of the distillation of the anilin is uncertain. When it is judged that all has come over, detach the receiver, and collect further distillate in another vessel and titrate separately.

Prepare the volumetric bromide solution by Seidell's method.†

Preliminary tests with this method on hydrogen dioxide solutions, which showed no acetanilid by the iso-nitril reaction, gave the following results:

.050 gm.	acetanilid	added,	.052 gm.	recovered.
.025 "	"	"	.026 "	"
.025 "	"	"	.026 "	"

Total Solids:—The U. S. P. method was used.

Phosphoric Acid:—The residue from the determination of total solids (=20 cc. hydrogen dioxide) was dissolved in hydrochloric acid, and phosphoric acid determined by the usual fertilizer method.

* Jour. Ind. and Eng. Chem., 1909, *1*, 262.

† Jour. Am. Chem. Soc., 1907, *29*, 109.

Results of Examination.

The amount of hydrogen dioxide ranged from 0.63 to 3.49 per cent. Three samples exceeded the required strength, six showed a deficiency less than 0.10 per cent., seven a deficiency from 0.11 to 0.20 per cent., five a deficiency from 0.21 to 0.30 per cent., six a deficiency from 0.33 to 0.53 per cent.; three were deficient over one per cent.; and two over two per cent.

Granting a variation of 10 per cent from the standard strength, twenty-one samples could be passed on the basis of content of hydrogen-dioxide, while eleven were deficient by 0.33 to 2.37 per cent. absolute dioxide, or were, in other words, only from 21 to 89 per cent. of standard strength.

The Pharmacopœia sets the limit of total solids at 0.03 gm. for 20 cc. of the solution, or 0.15 per cent. The solids in the samples examined ranged from 0.042 to 0.366 per cent. Only two samples appreciably exceeded the limit. The color of the solids varied from white to a dirty brown.

The acidity of 25 cc. of the solution ranged from 0.95 to 9.25 cc. of tenth-normal alkali. Fourteen samples fell within the U. S. P. limit of 2.5 cc., five required from 2.50 to 3.0 cc., eight from 3.0 to 5.0 cc., and five over 5.0 cc. All but four of the samples, Nos. 23014, 23093, 23306 and 23314, indicated the presence of sulphuric acid. Chlorin was found in all samples, No. 23093 showing only a trace. Nitric acid was detected in no case. Phosphoric acid was found in all samples except No. 23306, but in many cases only in traces, seventeen samples showing less than 0.01 per cent. In No. 23321, however, this acid was found in very excessive quantities, viz., 0.227 per cent.

Acetanilid was found in twenty-two of the twenty-three samples guaranteed to contain it, in quantities ranging from 0.060 to 0.204 grains per fluidounce, as a rule in substantial agreement with the claimed amounts. No acetanilid could be detected in No. 23059, although it was claimed on the label. Seven other samples contained no acetanilid. This preservative was found in Nos. 23291 and 23142 to the amount of 0.144 grains per fluidounce. This was not stated on the labels of these samples, and the boric there claimed to be present we were unable to detect.

In no case was more than a slight pressure observed on opening the bottles.

confined to the higher priced samples.

Summary.

The results of the examination may be summarized as follows, "standard strength" or "satisfies guarantee" meaning in all cases a deficiency of less than ten per cent.; an asterisk (*) denotes that acetanilid was present but was legally declared on the label:

Satisfies Guarantee and U. S. P. Requirements.

23046. Oakland (Dioxogen).

Standard Strength and Satisfy U. S. P. Requirements, Acetanilid present but declared on label.

***23014.** Albany.
***23296.** Arthur.
***23295.** Hull.
***23316.** Powers-Weightman-Rosengarten.
***23093.** Parke, Davis & Co.
***23312.** Powers-Weightman-Rosengarten.
***23306.** Williams and Carleton.
***23092.** Curtis.
***23273.** Osborn.

Satisfy U. S. P. Requirements except as to Limit of Acidity.

***23264.** Albany.
***23265.** Hydrox.
***23244.** Hydrox.
***23194.** Lehn and Fink.
***23121.** Lehn and Fink.
***23209.** Mallinckrodt.
***23310.** Middletown.
23314. Squibbs.
***23311.** Washburn.

Satisfy U. S. P. Requirements except as to Limit of Acidity. Acetanilid present but not declared on label.

23291. Apothecaries Hall.
23142. Apothecaries Hall.

Below Standard Strength.

23059. A. D. S. (89.3%).
***23059.** Carleton & Hovey (63.0%).
23219. Merck (82.3%).

Below Standard or Guaranteed Strength, and exceed U. S. P. limit of acidity.

23307. Marchand (75.9%).
23313. Marchand *(55.6%).
†**23272.** Marchand (21.0%).
***23266.** Murphy (84.7%).
***23315.** Shartenberg & Robinson (87.7%).
***23322.** Thayer (89.0%).

Below Standard Strength, and High Solids.

23048. Lawrence (57.7%).

Below Standard Strength, High Solids, High Acidity.

23321. Conway & Currier (88.3%).

TINCTURE OF IODINE.

Forty-three samples were examined. Of these twenty-eight showed less than a 10 per cent. variation from the U. S. P. standard.

Fourteen samples were below standard, ranging from 6.22 to 4.28 gms. of iodine per 100 cc., or from 88.9 to 61.1 per cent. U. S. P. The druggists selling the deficient samples were as follows:

T. Weldon & Co., South Manchester (88.9).
Madden's Drug Store, Bristol (87.6).
H. N. Lebell, Windsor Locks (87.1).
Balch & Brown, Manchester (85.9).
Burton L. Bennett, Bristol (85.7).
Perry N. Holley, Bristol (82.4).
John L. Thurlough, Canaan (82.0).

† While this sample showed a very high acidity, 9.20, as well as a great deficiency in hydrogen dioxide, it is only fair to the manufacturer to state that this material came to us in the original container with the seal unbroken, but *not* enclosed in a carton or the customary paper covering. Moreover, the glass was white, not amber as in the case of all other samples but the Marchand brands, and it is not difficult to understand the reason for its abnormal composition. This explanation, however, in no way helps the purchaser of this sample, who received a material only one-fifth of the standard strength.

Anders Jacobsen, Stafford Springs (87.1).
Modern Pharmacy (D. P. Auclair), Jewett City (80.0).
Waterville Drug Store (G. A. Sayers), Waterville (80.0).
Burtsch's Drug Store, Stonington (77.7).
P. F. Bray, Norwich (76.6).
H. A. Smith, Collinsville (68.7).
George E. Dresser, Putnam (61.1).

A sample sold by W. W. Woodward, Danielson, while of standard strength, was incorrectly labeled "Iodine" instead of "Tincture of Iodine."

The average of the forty-three samples was 6.52 gms. of iodine per 100 cc., compared with 6.43 gms. last year for ninety-two samples.

LIME WATER.

(*Liquor Calcis.*)

The U. S. Pharmacopœia defines lime water as "a saturated aqueous solution, which should contain not less than 0.14 per cent. of pure Calcium Hydroxide ($Ca(OH)_2$)."

"Fifty cc. should require for complete neutralization, not less than 19 cc. of tenth-normal sulphuric acid V. S. (corresponding to about 0.14 per cent. of calcium hydroxide), phenolphthalein T. S. being used as indicator."

Forty-one samples were examined by the U. S. P. method. These contained from 0.030 to 0.173 per cent. calcium hydroxid. Thirty samples equalled or exceeded the required strength, two were slightly below, while nine were distinctly inferior. The following tabulation shows the druggists selling the low grade lime water, together with its relation to U. S. P. strength:

	U. S. P. per cent.
T. J. Blake, Jr., Hartford	86.4
Coughlin's Pharmacy, Danbury	79.3
C. E. Pickard & Co., Bridgeport	72.1
J. T. Hillhouse, New Haven	55.0
F. E. Graves, Hartford	46.4
Brennan's Drug Store, Naugatuck	*37.1*
6 Corner Drug Store, New Haven	30.7
J. A. Leverty & Bro., Bridgeport	25.7
D. J. Tucker, Wallingford	21.4

MISCELLANEOUS DRUG PREPARATIONS.

Bay Rum. **21378.** *Superior Bay Rum,* J. H. Frost, New Haven; price, 20 cents per pint. It had a specific gravity at 15.6° C. of .9492, and *contained 33.54 per cent. by volume of methyl (wood) alcohol, and was artificially colored.*

21372. *Bay Rum,* J. H. Frost, New Haven; price, 50 cents per 2 ounce jar. *A crystalline solid, colored with a coal-tar dye, and containing 93.32 per cent. of common salt.* Loss at 100° C., 5.17 (volatile oil and water). This is a grossly adulterated article sold to barbers in unfair competition with high-grade bay rum. The manufacturer recommends the use of two ounces to make one gallon and one-half, using either water, grain alcohol or wood alcohol as desired.

Perfumery. **21371.** *Eau de Vie Cologne,* and **21373,** *Violet Water,* J. H. Frost, New Haven; price of each, 50 cents per 2 ounce jar. These preparations are similar to **21372,** except for the perfume used. The samples *contained 97.71 and 96.62 per cent. of common salt,* and lost at 100° C., 0.27 and 0.62 per cent., respectively. *Both were colored with a coal-tar dye.*

Castor Oil Pills. **21642.** *Arthur's Castor Oil Pills,* commonly known as Compound Cathartic Pills, U. S. P., The Five and Ten Cent Drug Cabinet Co., New Haven. Sold by Mayer & Loeb, New Haven; price, 10 cents a box. In analysis they agreed quite closely with the U. S. P. preparation. Soluble in alcohol, 34 per cent., insoluble in alcohol (mercurous chlorid and sugar), 66 per cent., soluble in ether (gamboge resin and yellow wax), about 5 per cent., insoluble in ether (jalap, colocynth and gamboge gum), about 17 per cent. The sample is *misbranded, as no castor oil is present.*

Extract of Peppermint. **21634.** *Williams' Pure Extract Peppermint,* The Williams & Carleton Co., Hartford, Conn. Sold by O'Connell's Grocery, Whitneyville; price, 10 cents per bottle. It contained 3.2 per cent. oil of peppermint, whose refractive index was 1.4638 at 20° C. Its specific gravity was .88897 at 15.6° C., and it contained 66.92 per cent. of alcohol by volume (no methyl alcohol present). This sample satisfied the flavoring extract standard.

Spirits of Peppermint. **21640.** *Arthur's Spts. Peppermint,* U. S. P. (contains alcohol 85.5), The Five and Ten Cent Drug

Cabinet Co., New Haven. Sold by Mayer & Loeb, New Haven; price, 10 cents per bottle. Spiritus Menthae Piperitae of the U. S. P. is a 10 per cent. solution of oil of peppermint in strong alcohol. This sample contained 10.8 per cent. oil of peppermint and 83.08 per cent of alcohol by volume (no methyl alcohol present). The oil had a refractive index of 1.4618 at 20° C.

Extract of Witch Hazel. **21641.** *Williams' Pure Extract Witch Hazel* (Pure Grain Alcohol, 15 per cent.), The Williams & Carleton Co., Hartford, Conn. Sold by Mayer & Loeb, New Haven; price, 10 cents per bottle. It showed a specific gravity of .98008 at 15.6° C., and contained 15.67 per cent. of alcohol by volume (no methyl alcohol present).

21647. *Double Distilled Witch Hazel* (Contains 15 per cent. alcohol), bottled for The Five and Ten Cent Drug Cabinet Co., New Haven. Sold by Mrs. Moore, Waterbury; price, 10 cents per bottle. It had a specific gravity of .98381 at 15.6° C. and contained 12.82 per cent. of alcohol by volume (no methyl alcohol present), somewhat lower than the amount claimed.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Forty-four samples of milk were tested. Thirty-six satisfied the legal standard, five were low in solids, two were skimmed and one was watered.

Cream. Twelve samples were tested, three of which contained artificial thickeners (in two cases sucrate of lime). One sample contained only 7.9 per cent. of fat; the other samples ranged from 13.0 to 17.5 per cent. of fat, all but one being below the standard.

Butter. Six samples were tested, and no adulteration was detected. Two of the samples, however, were of inferior quality.

Vinegar. Seven samples were tested, four of which were below standard in acidity.

Lemon Flavoring. The single sample sent in contained but 0.20 per cent. of lemon oil by volume, and was, therefore, far below standard.

Root Beer. The single sample showed a specific gravity at 15.6° C. of 1.0157, and contained 2.03 per cent. alcohol by volume (or 1.58 per cent. by weight), and 4.83 per cent. of extract (calculated).

Tri-Krema. Made by Curtis & Moore Co., Boston. It contained starch, a vegetable gum, probably tragacanth, and a small amount of gelatin, equal to 0.40 per cent. nitrogen. The material was sold as a thickener of ice cream, sherbet, whipped cream, etc.

Altar Wine. This sample had the following analysis: Specific gravity at 15.6° C., 1.0291, alcohol by volume, 17.22 (by weight, 13.25), extract, 13.00 gms., acidity as tartaric, 0.802 gms., ash, 0.1364 gm., alkalinity of ash, 13.2 cc. $\frac{N}{10}$ NaOH, sulphurous acid, 0.0067 gm., all in terms of 100 cc. of the wine. It contained no methyl alcohol or salicylic acid.

Sugar Gems. Sold by John Mason, East Orange, N. J. Some quotations from the literature accompanying this sample are worthy of notice.

> "SUGAR GEMS have now their absolute healthfulness placed beyond all doubt. The world's highest authorities . . . . , after thorough testing, state unanimously that this sweetener, under its various names, is *perfectly harmless* . . . . Sugar Gems are beyond all doubt *The Only Safe Sweetener* for children or nursing mothers, and the safest sweetener for everybody. . . . There are many very inferior imitations. The elements from which Sugar Gems are made are essentially the same, and in the same proportions as those of the delicious and costly Attar of Roses—the difference being caused only by the way in which the atoms are brought together. Sugar Gems are white—symbol of their unchanging Purity and Goodness. The natural color of sugar is brown, but a false whiteness is given by a mineral bluing in the 'refinery,' where dirty laborers sweat in a terrible heat over the harmful stuff . . . . Gems are 500 times stronger than sugar . . . . Try an 8 lbs.-strength Box, postpaid for 25 cents."

The sample proved to be essentially the coal-tar product, saccharin. The quotations above cited are mendacious and misleading. Saccharin has an important use in the diet of diabetics, to whom sugar in any form is poison, but its harmlessness is by no means proved. It certainly has no place in the diet of a normal man. Granting the truth of the statement that the "Gems are 500 times stronger than sugar," the "8 lbs.-strength Box" would contain only about one-quarter ounce of the substance, for which 25 cents is charged, four times the usual retail price of saccharin. The chemical similarity of saccharin and Attar of Roses is of course wholly imaginary.

Confectionery. Eleven samples were examined at the request of H. P. Fairchild, a graduate student at Yale University, to test the purity of the cheap grades of candy sold at the Greek-American stores in New Haven. The examination included a test of the purity of the chocolate used, the presence of mineral adulterants and the use of coal-tar colors. Six samples consisted of various chocolate-covered candies, three were mixed candies, one was peanut butter lozenges, and one wintergreen creams. The percentage of fat in the chocolate coatings ranged from 27.09 to 34.63, with a melting point of 28° to 29° C., and a refractive index of 1.4552 to 1.4572 at 40°C., corresponding satisfactorily to the constants for cacao butter. The ash in all cases was free from iron and other mineral adulterants.

The ash in ten samples ranged from 0.01 to 0.58 per cent.; in the peanut butter lozenges it was 0.95 per cent. The oil in this last-named sample had a refractive index of 1.4613 at 40° C., corresponding to that constant for arachis oil.

A red coal-tar dye was detected in five samples, and a yellow green and brown dye each in one sample. The dyes were not identified. These dyes constituted the only impurities found and were confined to five samples, three of which were the mixed candies.

Another sample of chocolate-coated taffy was sent in with the report that it had caused sickness. The chocolate coating contained 1.53 per cent. ash, and no adulteration or harmful substance was detected.

Headache Wafers. The sample was guaranteed to contain 5 grains of acetanilid per wafer; the two wafers analyzed contained 4.77 and 5.03 grains, about 50 per cent. of the total weight.

Formalin. The sample tested contained 36.30 per cent. of formaldehyde, very close to the U. S. P. strength.

Castor Oil Pills. The pills contained no castor oil, and they were therefore misbranded and their sale illegal.

One sample each of ginger, cinnamon, cornstarch, olive oil and tincture of iodine were examined and found pure and of standard strength.

Proprietary Medicines.

Six samples of medicine made by The Archibald-Ayers Co., New York, were submitted by a New Haven physician. The

smallness of the samples prevented a complete analysis, but the following data were secured:

21716. *The Archibald-Ayers Tonic.* "Unexcelled for all Catarrhal Conditions of the Blood affecting the Nose, Throat, Bronchial Tubes, Lungs, Stomach, Liver and Bowels, Kidney and Bladder, weak and irritable Heart, etc. Tones Digestion, enriches the Blood, etc." Price, $3.00 per bottle. The sample was acid to litmus, specific gravity at 15.6° C., 1.0332, alcohol by volume, 11.35 per cent. (8.72 by weight), extract, 12.45 per cent., ash, 1.70 per cent. Immersion refractometer at 20° C., 31 (no methyl alcohol), polarization at 24° C. before and after inversion, ± 0° (no sucrose). Residue on evaporation appeared like glycerol. Qualitative tests in the ash showed carbonates, chlorides, sulphates, phosphates, magnesia, much potash, and a trace of sodium.

21717. *Blood Medicine* (no label). Price, $5.00 per bottle. The sample was acid to litmus, specific gravity at 15.6° C., 1.0686, alcohol by volume, 18.30 per cent. (13.59 by weight), extract, 23.62 per cent., ash, 1.71 per cent. Immersion refractometer at 20° C., 39 (no methyl alcohol), polarization at 24° direct + 10.5, after inversion + 11.2 (sucrose none, glucose (?) 6.00 per cent.). Qualitative tests in ash showed carbonates, trace of sulphates and chlorides, phosphates, much potash, magnesia, and a trace of sodium. Port wine is evidently the base of this preparation, and from taste, odor and general appearance it seemed to be a coca wine. There was insufficient sample to permit identification of the suspected alkaloid.

21718. *Cerate.* "For Ovarian Pains, Inflammation, Displacement of Womb, Neuralgia, Pains in Back, Limbs, Spine and Nervous Disorders." Price, $3.00 per box. Loss on evaporation at 100° C., 5.12 per cent. (largely camphor); the filtered fat had a refractive index of 1.4567 at 40° C., corresponding to that of cacao butter, which is the base of the preparation.

21719. *Archibald-Ayers' Pile Salve.* "For Rectal Inflammation, Irritation, Protruding or External Hemorrhoids (Piles), Fissures, Fistula, Bleeding, Pain, Soreness and Swelling." Price, $3.00 per box. Loss on evaporation at 100° C., 2.73 per cent. (largely camphor); the filtered fat had the same refraction as **21718**, cacao butter again being the base of the preparation.

21720. *Archibald-Ayers' Pile Remedy.* "This remedy properly applied will remove and cure irritation, congestion, and swelling of painful or bleeding piles, fistula, fissure or tumors in rectum, etc." Price, $7.00 per box of twenty-eight suppositories; color, brownish. Loss on evaporation at 100° C., 4.39 per cent. (largely camphor). This is apparently the same material as **21718** in a different form.

21721. Same label as **21720.** Price, $7.00 per box of twenty-eight suppositories; color, greenish. Loss on evaporation at 100° C., 2.85 per cent. (largely camphor). This is apparently the same material as **21719.**

In the absence of a complete analysis it is not fair to state that these preparations possess no medicinal value, although the circumstances attending their sale strongly savor of quackery. Whether their value as medicine is large or nothing at all, a very important consideration is their exorbitant price. In **21716** and **21717** the addition of a small amount of medicament has increased the cost of an inferior grade of wine from a few cents to from $3.00 to $5.00 per half pint. In the case of the suppositories, which weighed about 0.5 gm. each, $225 per lb. was paid for what was almost entirely cacao butter.

Four other samples, purporting to be catarrh medicines, were sent in by another New Haven physician. They were made by Hayes-Agnew, Buffalo, N. Y. Like the other set of samples, only a small quantity was submitted and the analysis is therefore far from complete and entirely qualitative.

22131. Marked "No. 781." A milky-white emulsion, very viscid. Peppermint oil present, no iodides, bromides or chlorides present. By the official method for total alkaloids an appreciable residue more or less crystalline (hair-like crystals) was obtained, too small to test further except with concentrated nitric acid. No color was produced on this treatment. Atropine, caffeine, conine and other alkaloids might behave thus, but no confirmatory tests could be made.

22132. Marked "No. 967." A colorless liquid. Iodides present, no bromides or chlorides present, no iron was found. A test for alkaloids resulted as in previous sample.

22133. Marked "No. 769 A. C." A pink liquid. Iodides present in quantity, no bromides, chlorides or iron present. Alkaloids as in **22131.**

22134. Marked "No. G. P." A yellow liquid. No iodides, bromides or chlorides present, iron present. The alkaloids were isolated as in **22131.** The colorless residue treated with concentrated nitric acid gave a yellow color. This reaction might indicate codeine, morphine, thebaine and other alkaloids. On heating with nitric acid morphine should give a red color, but no red color was obtained. There was no evidence of morphine, and no other alkaloid could be identified.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1909.

The following samples were referred to this station by the Dairy Commissioner for examination:

Butter and Butter Substitutes. Of the sixty samples examined, twenty were unadulterated, twenty-four were oleomargarine and sixteen were renovated butter. Four samples of oleomargarine were sold without the display of the required sign, and fourteen samples of renovated butter unstamped. Eleven samples sold as butter proved to be oleomargarine and two renovated butter. Three samples sold as renovated butter were oleomargarine. Six samples of oleomargarine were examined for color with negative results.

Catsup. One sample examined was a properly labeled "compound"; the other was marked "made with benzoate of soda." It contained 0.24 per cent. of the preservative.

Cod Fish. The one sample examined contained no preservative.

Cream. One sample thickened with sucrate of lime was examined.

Lard. The four samples examined were found to be compound lard, but in each case were sold for pure lard.

Lemon Extract. Of the twenty-seven samples examined, four were not adulterated, fourteen were adulterated, and nine compounds, eight of which were illegally labeled.

Meat Juice. The sample examined was below standard.

Milk. One hundred and fourteen samples were examined; of these eighty-three were of standard composition. Of the deficient samples fifteen were watered and seven were skimmed.

Molasses. No adulteration was found in the two samples examined.

Pickles. The single sample examined was not found to be adulterated.

Preserves. The single sample examined was a properly labeled "compound."

Vanilla Extract. Sixteen samples were examined. Five of these were pure, one was adulterated and ten were compounds. Seven of the latter were illegally labeled in one or more particulars.

Vinegar. Two hundred and five samples were examined, of which one hundred and fifty-five were up to standard, twenty-eight were below standard, and twenty-two were illegally sold. The latter class includes samples of syrup, distilled and sugar vinegars sold as cider, malt or wine vinegar.

Waverly Shortening. This was a lard substitute properly labeled "compound" and consisted of beef stearin and cotton-seed oil.

Bay Rum. Five samples were examined, four of which were adulterated. Three contained methyl alcohol and one was a solid consisting chiefly of common salt, colored with a coal-tar dye.

Beef, Iron and Wine. The two samples examined were illegally labeled.

Spirits of Camphor. The single sample examined was of standard strength.

Castor Oil Pills. The sample was misbranded, as it contained no castor oil.

Camphor Liniment. Of the fifty samples examined, thirty were below standard. (See page 246.)

Catarrh Remedies. Four samples were examined, three of which were illegally sold, as they contained cocaine. (See page 249.)

Tincture of Ginger. The single sample examined was of standard strength.

Headache Pills. The sample contained the amount of acetanilid guaranteed on the label.

Tincture of Iodine. Six samples were examined, two of which were below standard.

Lime Water. Six samples were examined, four of which were below standard.

TABLE XLI.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1909.

	Not found *Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Breakfast Foods	35	14	--	49
Coffee	28	--	--	28
Condensed Milk	32	4	--	36
Dessert Preparations	--	--	--	4
Gelatin	10	6	--	16
Grape Juice	6	1	2	9
Jelly Powders	2	1	9	12
Lard	97	7	--	104
Lemon Extract	22	15	18[1]	55
Maple Syrup	8	--	22	30
Milk Powder	1	--	--	1
Olive Oil	44	--	--	44
Peanut Oil	1	--	--	1
Pickles	14	2	18[2]	34
Sardines	43	1	--	44
Sausage	--	--	--	51
Syrup	--	--	1	1
Temperance Drinks	--	--	--	11
Vanilla Extract	38	2	25[3]	65
Bay Rum	--	2	--	2
Camphor Liniment	81	77	--	158
Castor Oil	22	--	--	22
Castor Oil Pills	--	1	--	1
Catarrh Powders	5	1	--	6
Coca Wine	--	--	--	18
Cod Liver Oil	66	4	--	70
Cologne	--	1	--	1
Hydrogen Dioxide	1	22	9	32
Tincture of Iodine	28	15	--	43
Kola Wine	--	1	--	1
Lime Water	32	9	--	41
Extract of Peppermint	1	--	--	1
Spirits of Peppermint	1	--	--	1
Violet Water	--	1	--	1
Extract of Witch Hazel	2	--	--	2
Total	620	187	108	995
Sampled by Dairy Commissioner.				
Butter and Butter Substitutes	20	34	6	60
Catsup	--	--	2	2
Cod Fish	1	--	--	1
Cream	--	--	1	1
Jam	--	1	--	1
Lard	--	4	--	4

* Also includes misbranding.
[1] 17 illegally labeled.
[2] 3 illegally labeled.
[3] 11 illegally labeled.

TABLE XLI.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1909—*Continued.*

	Not found *Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Dairy Commissioner.				
Lemon Extracts	4	14	9[4]	27
Meat Juice	--	1	--	1
Milk	83	31	--	114
Molasses	2	--	--	2
Pickles	1	--	--	1
Preserves	--	--	1	1
Vanilla Extracts	5	1	10[5]	16
Vinegar	155	50	--	205
Waverley Shortening	--	--	1	1
Bay Rum	1	4	--	5
Beef, Iron and Wine	--	2	--	2
Spirits of Camphor	1	--	--	1
Camphor Liniment	20	30	--	50
Castor Oil Pills	--	1	--	1
Catarrh Remedy	1	3	--	4
Tincture of Ginger	1	--	-	1
Headache Pills	1	--	--	1
Tincture of Iodine	4	2	--	6
Lime Water	2	4	--	6
Total	302	182	30	514
Sampled by Health Officers, Consumers and Dealers.				
Butter	6	--	--	6
Castor Oil Pills	--	1	--	1
Catarrh Remedies	1	4	--	5
Cinnamon	1	--	--	1
Confectionery	7	5	--	12
Corn Starch	1	--	--	1
Cream	1	10	1	12
Formalin	1	--	--	1
Ginger	1	--	--	1
Headache Wafers	1	--	--	1
Tincture of Iodine	1	--	--	1
Lemon Extract	--	1	--	1
Milk	36	8	--	44
Olive Oil	1	--	--	1
Proprietary Medicines	--	--	--	10
Root Beer	--	--	--	1
Sugar	3	--	--	3
Sugar Gems	--	1	--	1
Tri-Krema	--	--	--	1
Vinegar	3	4	--	7
Wine	--	1	--	1
Total	64	35	1	121
Total from all sources	986	404	139	1630

* Also includes misbranding. [4] 8 illegally labeled. [5] 7 illegally labeled.

PART III.

COMMERCIAL FEEDING STUFFS.

By E. H. Jenkins and J. P. Street.*

THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following*:—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentage of protein and fat contained in it.

Section 4593 requires every manufacturer, importer, agent, or seller to file with this station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this station to take samples from any manufacturer, importer, agent, or dealer, in a prescribed fashion, and requires this station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "together with such additional information in relation to the character, composition and use thereof as may be of importance."

* The analytical work here described has been done by Messrs. Street, Morrison, Roe and Shepard. The report has been prepared mainly by Mr. Street.

The dairy commissioner is charged with the enforcement of the provisions of these sections of the statutes.

In compliance with these requirements the following report has been prepared. The utmost brevity of discussion of work is made necessary by the limit imposed by law on the size of the report.

During the fall of 1909 the station sampling agent visited 45 towns and villages of this State and collected 226 samples of feeds as prescribed by law. The results of the chemical and microscopical examination of these samples are here given and discussed.

There are also given 75 analyses of samples sent by individuals.

Oil Seed Products.

Cotton Seed Meal, Sampled by the Station.

(Analyses on pages 300 and 301.)

Of the fifteen samples, one, **23557**, sold by C. A. Conant, Boston, had neither brand nor guaranty on the bags as required by law. The following brands failed to meet their guaranteed protein content by the amounts given: American Cotton Oil Co.'s, by 1.44 per cent., Buckeye brand by 1.44 per cent, Dixie brand, two samples, by 2.37 and 1.94 per cent., respectively, J. E. Soper's by 3.00 per cent., Star brand by 1.69 per cent.

One sample of the *Buckeye Brand,* **23511,** contained an excess of hulls, as shown by the percentage of fiber.

The average per cent. of protein is 39.83, somewhat lower than last year, while the average price is over two dollars higher.

Cotton Seed Meal, sampled by Purchasers.

21817, *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn., guaranteed 41 per cent. protein; sent by L. C. Brainard, Thompsonville; contained 42.31 per cent. protein.

21823, *Green Diamond Brand,* Chapin & Co., Boston; sent by Meech & Stoddard, Middletown; contained 43.06 per cent. protein.

21998, sent by Colchester Grain & Coal Co., Colchester; guaranteed 38.5 per cent. protein; contained 39.62 per cent. protein.

22322, sent by Meech & Stoddard, Middletown; guaranteed 39 per cent. protein; contained 39.62 per cent. protein.

22544, Hunter Bros. Milling Co., St. Louis, Mo., guaranteed 38.5 per cent. protein; sent by R. B. Eno, Weatogue; contained 42.56 per cent. protein.

23837, Humphreys, Godwin & Co., Memphis, Tenn.; sent by The Coles Co., Middletown; contained 38.37 per cent. protein.

23838, Humphreys, Godwin & Co., Memphis, Tenn.; guaranteed 41 per cent. protein; sent by The Coles Co., Middletown; contained 36.87 per cent protein.

23839, *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn.; guaranteed 41 per cent. protein; sent by L. C. Brainard, Thompsonville; contained 41.37 per cent. protein.

23841, sent by Meech & Stoddard, Middletown; guaranteed 39 per cent. protein; contained 39.12 per cent. protein.

23842, J. E. Soper & Co., Boston, Mass.; guaranteed 38.5 per cent. protein; sent by The T. E. Main & Sons Co., Moosup; contained 39.44 per cent. protein.

23861, *Buckeye Brand,* The Buckeye Cotton Oil Co., Cincinnati, O.; guaranteed 39 per cent. protein; sent by Wheeler & Co., Bridgeport; contained 37.31 per cent. protein.

23865, *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn.; guaranteed 38.5 per cent. protein; sent by T. S. Gold & Son, West Cornwall; contained 37.13 per cent. protein.

23892, sent by The Coles Co., Middletown; contained 40.69 per cent. protein.

23896, *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn.; guaranteed 38.5 per cent. protein; sent by H. B. Coger, Botsford; contained 37.75 per cent. protein.

23897, Humphreys, Godwin & Co., Memphis, Tenn.; sent by The Coles Co., Middletown; contained 41.13 per cent. protein.

23923, and **23924,** sold by Bosworth Bros., Putnam, and W. E. Wheelock, Quinnebaug, respectively, and sent by L. H. Healey, North Woodstock, contained 39.00 and 38.38 per cent. protein.

22011, *Prime Cotton Seed Feed,* Southern Fibre Co., Portsmouth, Va.; guaranteed 10 per cent. protein; sent by F. Chamberse, Waterbury; contained 10.62 per cent. protein.

23860. A sample of cotton seed meal from R. W. Jennings, Torrington, from a car lot, contained 27.75 per cent. of protein, ten and three-quarters per cent. less than guaranteed. It was stated later that the sample was taken from a single sack which had been torn open, and therefore represented nothing more

than the contents of one sack. Later Mr. Jennings sent another sample with the statement that it was a portion of a sample drawn from twenty-one bags. It came in four packages in which protein was separately determined. The percentages were 37.38, 37.19, 37.30, 36.94, being practically alike, the average being 37.20. At the same time the shipper's agent drew fourteen samples from different sacks, sending half of each to the seller and half to this station. In each of these protein was determined with the following percentage results: 38.13, 36.75, 37.88, 36.63, 35.25, 33.88, 39.00, 35.81, 28.13, 36.63, 38.75, 36.63, 37.94, 39.31; average, 36.48.

Obviously two bags in the fourteen contained very inferior meal. Excluding them, the average protein is 37.40, about what was found in the sample sent by Mr. Jennings. The average of the car is good, but the purchaser of a single bag or two might get very poor meal. There is no good excuse for the presence of such inferior meal. On the other hand, those drawing samples should take great care to have the sample sent representative of the whole lot, thus avoiding unnecessary work and misunderstanding. At least twenty sacks should be opened and sampled from each car lot.

It is now possible for users of cotton seed meal in car lots to buy it with a guaranty and also with an agreement from the seller, which appears on every tag, to deduct from the cost for any deficiency in protein under named and reasonable conditions.

Linseed Meal, sampled by the Station.

(ANALYSES ON PAGES 300 AND 301.)

Three samples of new process and four of old process meal satisfied their guaranties in every case except Sample **23606**, which was low in fat.

Linseed Meal, sampled by the Purchasers.

22124. Old Process meal, sent by Meech & Stoddard, Middletown; contained 35.12 per cent. protein.

22381. Old Process meal, *Cow Brand*, New Jersey Oil & Meal Co.; guaranteed 30 per cent. protein; sent by C. D. Stillson, Stepney Depot; contained 26.69 per cent. protein and 8.45 per cent. fiber. A microscopical examination showed it to contain a rather large amount of weed seeds and cocoa shells.

Wheat Products.

Whole Wheat.

21818. Wheat damaged by smoke and water and then probably kiln dried; sent by D. O. Meeker, West Cheshire; contained 12.19 per cent. protein and 1.85 per cent fat.

Bran from Winter Wheat.

(Analyses on pages 300 to 303.)

23527, Voigt's Bran did not have a guaranty as required by law, but the manufacturer, on being advised of the law, has taken steps to conform with it. The other fifteen samples were properly guaranteed and twelve of them met their guaranties. *Vimco Bran,* **23506,** was 1.06 per cent. low in protein, and *Adrian Bran,* **23590,** the bran of the Southwestern Milling Co., **23500,** and that of Hecker-Jones-Jewell Milling Co., **23437,** were all low in fat.

Bran from Spring Wheat.

(Analyses on pages 302 and 303.)

23565, *Lucky Bran,* and **23573,** the bran of the Geo. Urban Milling Co., were not guaranteed as required by law. The Geo. Urban Milling Co., on being advised, write that the matter will be properly attended to. The samples of these brans had considerably less fat than average wheat bran. The other ten samples were properly guaranteed and had the guaranteed amounts of protein and fat.

The single sample of unclassified bran satisfied its guaranty.

Middlings from Winter Wheat.

(Analyses on pages 304 and 305.)

The ten samples were properly guaranteed and all satisfied their guaranties except **23465,** Hecker-Jones-Jewell Milling Co., which was slightly low in fat.

Middlings from Spring Wheat.

(Analyses on pages 304 and 305.)

23549, *New Star Middlings,* and the middlings of the Geo. Urban Milling Co., **23572,** were not guaranteed as required by law. The other fourteen samples were properly guaranteed and

all satisfied their guaranties except **23620**, *Bay State*, and **23619**, *Sleepy Eye*, which were low in fat.

Of the two unclassified middlings, one satisfied its guaranty; the other, **23501**, *Colonial Middlings*, likewise satisfied its guaranty, but is not pure wheat middlings, as it contains a corn product; its selling price, $32.00, was over $2.00 higher than the average price of standard middlings.

Wheat Feed from Winter Wheat.

(ANALYSES ON PAGES 306 AND 307.)

23495, *Hope Mills Feed*, and **23497**, *Snowflake Mixed Feed*, were not guaranteed as required by law, but the manufacturers, being advised of the law, have taken steps to comply with it. The other fifteen samples were properly guaranteed, and all satisfied their guaranties except **23597**, *Cream Feed*, and **23616**, *Star and Crescent Mixed Feed*, which were both low in fat.

Wheat Feed from Spring Wheat.

(ANALYSES ON PAGES 306 TO 309.)

23626, *Lucky Mixed Feed*, and **23588**, *Faylor's Mixed Feed*, were not guaranteed as required by law. The other nine samples were properly guaranteed and all satisfied their guaranties.

Of the unclassified wheat feeds, **23499**, *Columbia Mixed Feed*, did not bear the required guaranty, but we are assured by the manufacturers that it will be properly tagged hereafter. The other two samples were properly guaranteed and both satisfied their guaranties.

Red Dog Flour.

(ANALYSES ON PAGES 308 AND 309.)

The single sample was not guaranteed as required, but was of average composition.

Wheat Feeds, sampled by Purchasers.

21987, *Winona Bran*, and **21988**, *Globe Bran*, sent by Wilson H. Lee, Orange, contained 16.00 and 16.75 per cent. protein, respectively. **22469**, middlings, sent by E. DeWolfe, Rockville, contained 15.69 per cent. protein and 1.75 per cent. ash. **23357**, middlings, Eckhart & Swan Milling Co., Chicago, Ill., sent by E. H. Lyman, Torrington, contained 10.27 per cent. water, 16.69

per cent. protein and 5.95 per cent. fat. **22329**, *Huron Mixed Feed,* Chapin & Co., Boston, Mass., sent by G. M. White & Co., Hartford, contained 17.25 per cent. protein. **23395**, wheat feed, sent by Abner Hendee, New Haven, contained 17.19 per cent. protein.

Maize Products.

Maize Meal.

One sample of corn meal, **23864**, made by H. B. Coger, Botsford, contained 8.94 per cent. protein.

Maize (Grain).

Eight samples of corn were analyzed, chiefly in connection with variety tests of high protein strains. **21982**, **21983** and **21984**, sent by Geo. S. Anthony, Wallingford, contained 10.44, 10.37 and 10.25 per cent. protein, respectively. **22042** and **22043**, sent by Dennis Fenn, Milford, contained 9.06 and 9.56 per cent. protein. **22421**, **22422** and **22423**, sent by David S. Kelsey, West Hartford, contained 11.12, 8.75 and 10.06 per cent. of protein, respectively.

Gluten Feed, sampled by the Station.

(Analyses on pages 308 to 311.)

Nine brands were found on sale in the State, and these are represented by sixteen analyses.

Atlantic Gluten Feed, made by the Atlantic Starch Works, Westport, satisfied its guaranty. This is made from wheat gluten and contains from four to five per cent. more protein than the high-grade corn gluten feeds, while its price is somewhat lower.

Buffalo Gluten Feed, made by the Corn Products Refining Co., Chicago. Three of the four samples met their guaranties. One was deficient in fat. All the samples were stated to be artificially colored.

Cream of Corn Gluten Feed, made by the American Maize Products Co., New York. One of the two samples was deficient in fat, and one was stated to be artificially colored.

Crescent Gluten Feed, made by the Corn Products Refining Co., New York. The single sample failed to meet its fat guaranty; it was stated to be artificially colored.

Clinton Gluten Feed, made by the Clinton Sugar Refining Co., Clinton, Ia. Both samples substantially met their guaranties.

Globe Glüten Feed, made by the Corn Products Refining Co., New York and Chicago. The three samples all met their protein guaranties but one was deficient in fat. All were stated to be artificially colored.

Jenks Gluten Feed, made by the Huron Milling Co., Harbor Beach, Mich., substantially met its guaranty. It contains a low per cent. of ash with a high per cent. of fat, 9.12, indicating the possible addition of corn germ to the feed.

K. K. K. Gluten Feed, made by the J. C. Hubinger Bros. Co., Keokuk, Ia., and *New England Gluten Feed,* from J. E. Soper & Co., Boston, both satisfied their guaranties.

Gluten Feeds, sampled by Purchasers.

21820, *Wheat Gluten,* sent by Meech & Stoddard, Middletown, contained 39.12 per cent. protein. **21989,** unknown brand, made by the Corn Products Refining Co., sent by Wilson H. Lee, Orange, contained 26.94 per cent. protein. **22123,** *Gluten Feed,* sent by Meech & Stoddard, Middletown, contained 20.81 per cent. protein. **22159,** *International Gluten Feed,* made by the Globe Elevator Co., Buffalo, N. Y., guaranteed 20 per cent. protein, sent by H. G. Manchester, Winsted, contained 21.56 per cent. protein. **23898,** *Crescent Gluten Feed,* made by the Corn Products Refining Co., guaranteed 25 per cent. protein, sent by Andrew Kingsbury, Rockville, contained 27 per cent. protein.

Hominy Feed, sampled by the Station.

(Analyses on pages 310 to 313.)

Nineteen samples were analyzed, all of which were guaranteed, and substantially met their guaranties except **23482,** which was slightly deficient in fat.

Hominy Feed, sampled by Purchasers.

22373, sent by H. B. Cooke, Georgetown, contained 11.62 per cent. protein. Two samples of *Blue Ribbon Hominy Chop,* sold by J. E. Soper & Co., Boston, both guaranteed 10 per cent. protein, and sent by Fred Lyman, Manchester, and Spencer Bros., Suffield, contained 11.12 and 10.81 per cent. protein, respectively.

Star Feed.

(ANALYSES ON PAGES 312 AND 313.)

This material, made by the Toledo Elevator Co., Toledo, O., is a mixture of hominy feed, corn and cob meal, and a small amount of salt. It contains only about four-fifths as much protein as hominy feed, and over twice as much fiber, while its selling price is only about $2.00 per ton less. The three samples analyzed met their guaranties.

Miscellaneous Maize Products.

(ANALYSES ON PAGES 312 AND 313.)

23443, *Corn Feed Meal*, made by the Quaker Oats Co., Chicago, satisfied its guaranty. It is made from yellow hominy feed, and conforms with the composition of high-grade hominy feed.

23493, *Screenings from Cracked Corn*, sold by W. O. Goodsell, Bristol, bore no guaranty. Its analysis showed it to contain considerable corn bran.

Corn and Cob Meal.

22168, **22169**, and **22170**, sent by R. H. Ensign, Simsbury, contained 8.81, 7.75 and 8.00 per cent. protein respectively, somewhat higher percentages than usually found in this product.

RYE PRODUCTS.

(ANALYSES ON PAGES 312 AND 313.)

One sample of rye feed, **23529**, made by the H. D. Stone Milling Co., Rochester, N. Y., was not guaranteed as required by law. The firm stated that it did not sell in sacks but often filled it in purchasers' sacks. The purchaser or dealer within this state is therefore responsible for properly tagging the packages.

BUCKWHEAT PRODUCTS.

(ANALYSES ON PAGES 312 AND 313.)

One sample each of buckwheat feed and middlings was analyzed, both of which satisfied their guaranties. The feed contained considerable of the hulls as shown by the high fiber percentage, 25.07. The middlings, as usual, was a very high-grade feed.

One sample of buckwheat flour, **23863**, made by E. F. Barnes, Rock Dale Mills, Mass., and sent by H. B. Coger, Botsford, contained 9.12 per cent. protein.

Barley Products.

Malt Sprouts.

(Analyses on pages 314 and 315.)

The two samples analyzed, met their protein guaranties, but were both somewhat low in fat. A guaranty of 2 per cent. is too high for pure malt sprouts.

A sample, **22356**, sent by Fred Lyman, Manchester, contained 27.37 per cent. protein.

Dried Distillers' Grains.

(Analyses on pages 314 and 315.)

Four samples, representing three brands, were analyzed. All of these were high-grade products, but *Connecticut Gluten,* **23516**, showed a marked deficiency in both protein and fat, and one sample of *Ajax Flakes* was over one per cent. low in protein. Attention is again called to the impropriety of giving the name "gluten feed" to distillery by-products.

Dried Brewers' Grains.

(Analyses on pages 314 and 315.)

The three samples analyzed were of good quality and satisfied their guaranties, except **23571**, *Schlitz's Dried Grains,* which was deficient in fat.

22158, made by The James Hanley Brewing Co., Providence, R. I., guaranteed 20 per cent. protein, sent by Andrew Kingsbury, Rockville, contained 24.87 per cent. protein.

Mixed Feeds.

The following paragraphs from an address of Dr. H. P. Armsby, a leading authority in animal nutrition, are worth the attention of manufacturers and of purchasers of mixed feeds:

"The feeder of the future will utilize by-product feeds to an extent as yet unrealized. He will pass in review the crude products of the farm, and all the hundred and one wastes of manufacturing operations, to see if perchance they still contain energy which he can extract. Like the miner, he will be ready to work

low-grade ore, provided there is a sufficient margin of profit. Even the small amounts of available energy contained in such feeds as oat hulls, corn cobs and the like will be utilized and their waste energy saved as rapidly and as far as economic conditions render profitable, and to aid in rendering this possible is to render service to mankind.

"It must be clearly understood, however, that this desirable end is not to be attained by any species of pious fraud. The manufacturers of mixed feeds are of late making much of the importance of by-product materials, a most sound proposition in itself, but one which hardly justifies all the corollaries which some of them appear to draw from it. That corn cobs, for example, contain a certain small amount of available energy does not render it an act of benovolence to induce the farmer to feed them, as Mike wanted his whisky supplied, 'unbeknownst,' in some mixed feed with a high-sounding name or as an inconspicuous admixture to some well-known material. Such surreptitious kindness is in danger, in the long run, of recoiling upon its author. We shall not effect the needed economies of the future by coaxing or beguiling the feeder into utilizing these low-grade materials as ingredients of patent feeds or pre-digested mixtures or ready-balanced rations, but by teaching him their true value and educating him to make his own mixtures and balance his own rations."

Corn and Oat Feeds.

(Analyses on pages 314 to 317.)

Nine of the samples included in this group are chiefly composed of corn and oat products. The composition of some of these indicates that they are mixtures of the whole of these two grains. Others indicate, however, that an inferior part of the grain has been used in their compounding; this is particularly noticeable in **23414**, *Jim Dandy Feed,* which contains a large proportion of oat hulls, with very little corn.

23598, *Cox's Oat Feed,* consists very largely of oat hulls, and shows only 5.06 per cent. protein with 25.92 per cent. of fiber. Such a feed at the price given cannot be an economical purchase under any possible circumstances.

One sample of *Korn-Oato* did not bear the required guaranty but the manufacturer states that it is now attached to all pack-

ages. **23558**, *Provender*, did not meet its protein guaranty, and **23512**, *Korn-Oato*, was low in fat.

Corn and Oats Feeds, sampled by Purchasers.

22371, sent by H. B. Cooke, Georgetown, contained 11.19 per cent. protein. **23012** and **23347**, sent by the manufacturer, Meech & Stoddard, Middletown, contained 6.87 and 7.00 per cent. protein, respectively, and the latter 3.35 per cent. fat. **23862**, sent by H. B. Coger, Botsford, contained 9.50 per cent. protein.

22632, *Oat Dust*, screened from high-grade Montana oats, sent by Meech & Stoddard, Middletown, contained 10.94 per cent. protein and 4.90 per cent. ash.

Wheat and Corn Cob Feeds.

(Analyses on pages 316 and 317.)

These feeds, while sold as *Mixed Feeds*, a name properly belonging from trade usage only to mixtures of wheat bran and middlings, bore tags which indicated the presence of corn cob. They sell on the average for about $3.00 less than genuine wheat feed, although one of the samples examined this year cost $30.00 per ton, and they contain only about two-thirds as much protein as wheat feed. The three samples examined were guaranteed, and all satisfied their guaranties.

Proprietary Horse Feeds.

(Analyses on pages 316 and 317.)

Of the eight samples examined, one, **23550**, *Molac Molasses Horse Feed*, did not bear the required guaranty. The manufacturers write that this was an oversight which has been corrected. *Sucrene Horse and Mule Feed*, **23622**, and *Algrane Horse Feed*, **23475**, were below guaranty in fat, and *Bonnie Horse Feed*, **23430**, was below guaranty in both fat and protein.

Molac Molasses Horse Feed contains corn and oat products, a little cotton seed and linseed meals, weed seeds and molasses.

Hexagon for Horses contains crushed oats and a corn product.

Sucrene Horse and Mule Feed contains corn, oats, barley and wheat products, weed seeds and molasses.

"Ubiko" Horse Feed contains wheat, corn and oat products, and cotton seed and linseed meals.

Buffalo Horse Feed contains corn, oats and a small amount of a wheat product.

Bonnie Horse Feed and Algrane Horse Feed contain corn, oat and wheat products.

Sugarota Horse Feed contains wheat, oats, and corn products, cotton seed meal, a little linseed meal, some weed seeds and molasses.

Proprietary Dairy and Stock Feeds.

(ANALYSES ON PAGES 318 TO 321.)

All of the twenty-six feeds of this class examined bore the required guaranties except **23494**, *Quaker Molasses Dairy Feed.* The manufacturers write that this was through an oversight which has been corrected. Of the other samples, two, **23484** and **23555**, *Sugarota Dairy Feed,* were below guaranty in protein, and three, **23431**, *Bonnie Dairy Feed,* **23537**, *Badger Stock Feed,* and **23603**, *Derby Stock Feed,* were below guaranty in fat.

Sucrene Dairy Feed contains distillery products, corn, oat and wheat products, cotton seed meal, a little linseed meal, weed seeds and molasses.

Unicorn Dairy Ration contains wheat, corn and brewery products, and cotton seed and linseed meals.

Biles' Union Grains contains wheat and corn products, distillery residues, malt sprouts, and cotton seed and linseed meals.

Blatchford's Calf Meal contains linseed, cotton seed and bean meals with fenugreek.

Buffalo Creamery Feed contains corn, wheat and oat products and cotton seed meal.

Daisy Dairy Feed contains corn, oat and rye products, malt sprouts, barley residues, cotton seed meal, some weed seeds and molasses.

Sterling Stock Feed contains corn, oat and wheat products, and a small amount of cotton seed meal.

Bonnie Dairy Feed contains corn, wheat and oat products and cotton seed meal.

New England Stock Feed contains ground corn and oats (largely hulls).

Badger Dairy Feed contains wheat and oat products, malt sprouts, distillery residues, ground alfalfa, cotton seed meal (?), some weed seeds and molasses.

Badger Stock Feed contains cracked corn, oat product, malt sprouts, ground alfalfa, some weed seeds and molasses.

Electric Stock Food contains barley and corn products, malt sprouts, some oat hulls and molasses.

Sugarota Dairy Feed contains wheat and oat products, distillery residues, linseed meal, cotton seed meal and some weed seeds and molasses.

Quaker Molasses Dairy Feed contains wheat, corn and oat products, weed seeds and molasses.

Schumacher's Stock Feed contains corn, oat and barley products.

Schumacher's Calf Meal contains ground oats, wheat product, linseed meal and a small amount of cotton seed meal.

Derby Stock Feed contains corn and oat products and possibly some cotton seed meal.

Alfalfa Stock Feed contains cracked corn, coarsely ground alfalfa and a wheat product.

Buf-Ce-Co Stock Feed, Wirthmore Stock Feed, Haskell's Stock Feed and *Economy Feed* consist chiefly of corn and oat products.

Dairy Feeds Sampled by Purchasers.

21815, *Bonnie Horse Feed,* sent by The Ferris Coal Co., South Norwalk, guaranteed 10.50 per cent. protein, contained 14.12 per cent. **22370**, *Biles' Union Grains,* guaranteed 24 per cent. protein, sent by H. B. Cooke, Georgetown, contained 25.00 per cent. **22372**, *Daisy Dairy Feed,* sent by A. W. Northrup, Ridgefield, guaranteed 14 per cent. protein, contained 16.50 per cent. **23859**, *Stock Food,* sold by The L. C. Daniels Grain Co., Hartford, sent by Geo. E. Brown, Bloomfield, contained 11.44 per cent. protein.

Proprietary Poultry Feeds.

(ANALYSES ON PAGES 320 AND 321.)

The eleven samples all bore the required guaranties. **23469**, *H. O. Poultry Feed,* and **23600**, *Purina Mill Feed Mash,* were both below guaranty in fat.

Buffalo Poultry Feed contains wheat, corn and a small amount of oat products.

Queen Poultry Mash contains corn and wheat products and ground alfalfa.

G. W. Alfalfa Meal and *Peters' Ground Alfalfa* consist of ground alfalfa, rather mature and carrying a large percentage of crude fiber.

Bonnie Poultry Feed and *H. O. Poultry Feed* consist chiefly of wheat and corn products.

Park & Pollard's Dry Mash Feed contains wheat, corn and oat products, ground alfalfa and animal matter.

Park & Pollard's Growing Feed contains chiefly corn, wheat and oat products.

Purina Mill Feed Mash contains wheat and corn products, ground alfalfa, a very small amount of dried blood and possibly a little cotton seed meal.

American Poultry Feed contains wheat and corn products with a little oats.

Every Morning Mash Feed contains wheat and corn products, ground alfalfa, animal matter and a small amount of cotton seed meal.

23464, *Hen-E-Ta Bone Grits,* made by the Hen. E. Ta. Bone Co., Flemington, W. Va., guaranteed 30 per cent. pure bone ash, and sold by R. G. Havis, New Haven, at $45.00 per ton, contained 10.07 per cent. phosphoric acid, equivalent to 22 per cent. calcium phosphate.

21819, *Beef Scrap,* said to be made from the refuse of extract of beef, sold by Park & Pollard Co., Boston, sent by D. W. Meeker, West Cheshire, price $3.00 per hundred, and guaranteed 75 per cent. protein, contained 82.69 per cent. protein and 10.33 per cent. fat.

Condimental Food.

23697, *Kow-Kure,* made by the Dairy Association Co., Lyndonville, Vt., sold by J. T. Benham Est., New Haven, price $1.00 per can.

It is recommended for "abortion (slinking), barrenness (failure to breed), scouring, bunches in the udder, red-water, and 'off feed.' Kow-Kure assists nature in removing retained afterbirth, makes pure blood, corrects stomach disorders, improves the appetite, and being a safe and powerful tonic, it makes a larger flow of milk." It is claimed to be compounded of twelve drugs, which we have made no attempt to identify completely. A partial analysis showed 13.94 per cent. protein, 14.19 per cent. total ash, 6.29 per cent. ash soluble in water and 0.81 per cent. sand

(insoluble in acid). The following ash ingredients were determined: iron oxide, 4.90 per cent., calcium oxide, 0.58 per cent., magnesium oxide, 4.03 per cent., phosphoric anhydride, 1.24 per cent., and sulphuric anhydride, 3.59 per cent., indicating that the mineral part of the mixture consisted chiefly of magnesium sulphate (Epsom salt) and an iron salt, probably the sulphate.

The exorbitant price of this and similar preparations, if nothing else, should prevent their use by the stockman, to whom economy is a matter of vital importance.

Apple Pomace.

23984, sent by J. A. Thompson & Son, Melrose, had the following composition:

Water	74.54
Ash	0.73
Protein	1.08
Fiber	3.38
Nitrogen-free Extract	19.13
Ether Extract	1.14
	100.00

Summary.

The following table shows the number of samples analyzed, the number sold without the required guaranty and also the number which failed to meet the manufacturer's guaranty.

Kind of Feed.	No. of Samples.	No. with Guaranty.	No. without Guaranty.	* Low in Protein.	* Low in Fat.	* Low in Both.
Cotton Seed Meal	15	14	1	4	-	2
Linseed Meal	7	7	-	-	1	-
Wheat Bran	29	26	3	1	3	-
Wheat Middlings	28	26	2	-	3	-
Wheat Feed	33	26	7	-	2	-
Gluten Feed	16	16	-	-	4	-
Hominy Feed	19	19	-	-	1	-
Star Feed	3	2	1	-	-	-
Rye Feeds	4	3	1	-	-	-
Buckwheat Feeds	2	2	-	-	-	-
Malt Sprouts	2	2	-	-	1	-
Distillers' Grains	4	4	-	1	-	1
Brewers' Grains	3	3	-	-	1	-
Corn and Oat Feeds	10	9	1	1	1	-
Wheat and Corn Cob Feeds	3	3	-	-	-	-
Horse Feeds	8	7	1	-	2	1
Dairy and Stock Feeds	26	25	1	2	3	-
Poultry Feeds	11	11	-	-	2	-
Bone Ash	1	1	-	-	-	-
Miscellaneous	2	1	1	-	-	-
	226	207	19	9	24	4

* Deficiencies of less than one per cent. protein and 0.25 per cent. fat are ignored in this tabulation.

Digestibility of Feeding Stuffs.

Table I shows the digestion coefficients, or percentages of the food elements which are digestible by neat cattle (Lindsey's Compilation, 17th Report Mass. (Hatch) Agrl. Station, 1905, page 240 *et seq.*).

TABLE I.

DIGESTION COEFFICIENTS.

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	84	35	78	94
Linseed Meal, new process	84	74	80	89
Linseed Meal, old process	89	57	78	89
Corn Meal	66	..	92	91
Homing Meal and Star Feed	65	67	89	92
Gluten Feed	85	76	89	83
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Mixed Feed	78	62	77	87
Rye Feed	80	..	88	90
Oats	77	31	77	89
Buckwheat Middlings	85	17	83	89
Malt Sprouts	80	34	69	100
Dried Distillers' Grains	73	95	81	95
Dried Brewers' Grains	81	49	57	89
Corn and Oat Feed, Provender	71	48	83	87
Wheat and Corn Cob Feed	63	28	71	92

THE AVERAGE COMPOSITION, DIGESTIBILITY AND SELLING PRICE OF COMMERCIAL FEEDS.

Table II contains a summary of the facts given in more detail in Table III and shows, first, the average composition of these feeding-stuffs as determined by our recent examination and arranged according to their percentage of protein; second, the amount of digestible matter in each feed, as far as we have been able to calculate it, and third, the average retail prices of the feeds in October and November last.

The feeds examined are tabulated in six groups. The statement on page 322 gives the average number of pounds of digestible protein, fiber and nitrogen-free extract and fat purchasable for one dollar in each of these groups.

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE.

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, etc.).	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
I. Protein over 30 per cent.											
Cotton Seed Meal	8.12	6.28	39.83	8.10	29.52	8.15	33.5	2.8	23.0	7.7	$34.85
Linseed Meal, new process	10.10	6.08	37.42	8.10	35.03	3.27	31.4	6.0	28.0	2.9	37.33
" " old process	10.31	5.36	34.66	7.20	36.66	5.81	30.8	4.1	28.6	5.2	36.00
Gluten Feed, Atlantic	5.21	1.13	32.81	1.40	58.38	1.07	27.9	1.1	52.0	0.9	30.00
Buckwheat Middlings	12.21	4.83	32.13	8.88	33.59	8.36	27.3	1.5	27.9	7.4	32.00
Ajax Flakes	5.51	2.70	30.25	10.86	37.52	13.16	22.1	10.3	30.4	12.5	34.00
II. Protein 30-25 per cent.											
Gluten Feed, Cream of Corn	8.57	2.38	27.75	7.22	51.12	2.96	23.6	5.5	45.5	2.5	32.00
Dried Brewers' Grains	8.18	3.22	27.71	13.32	40.65	6.92	22.4	6.5	23.2	6.1	29.33
Gluten Feed, Crescent	9.44	5.12	27.63	6.75	49.55	1.51	23.5	5.1	44.1	1.3	31.40
Corn Distillers' Grains	6.47	1.80	27.63	14.70	36.11	13.29	20.2	14.0	29.2	12.6	30.40
Gluten Feed, Globe	9.61	3.79	27.25	7.63	49.17	2.55	23.2	5.8	43.8	2.1	32.00
" " Buffalo	9.88	4.81	27.11	6.75	48.51	2.94	23.0	5.1	43.2	2.4	31.75
Malt Sprouts	9.91	5.63	27.10	10.38	45.40	1.58	21.7	3.5	31.3	1.6	27.50
Gluten Feed, Jenks	8.61	0.80	26.50	6.12	48.85	9.12	22.5	4.7	43.5	7.6	34.00
Connecticut Gluten	8.16	4.01	26.25	8.58	41.23	11.77	19.7	8.2	33.4	11.2	32.00
Unicorn Dairy Ration	9.05	2.96	25.94	8.86	45.73	7.46	----	----	----	----	33.00
III. Protein 25-20 per cent.											
Gluten Feed, New England	9.00	1.00	24.94	7.39	54.16	3.51	21.2	5.6	48.2	2.9	34.00
" " K. K. K.	7.55	1.53	24.81	7.98	53.72	4.41	21.1	6.1	47.8	3.7	32.00
Union Grains, Biles' Ready Ration	9.20	5.13	24.17	9.30	44.21	7.99	----	----	----	----	33.33
Gluten Feed, Clinton	10.00	0.95	22.63	6.65	55.63	4.14	19.2	5.1	49.5	3.4	32.00
Buffalo Creamery Feed	9.35	4.34	20.50	9.62	50.05	6.14	----	----	----	----	32.00
Ubiko Horse Feed	8.45	3.64	20.38	9.34	51.04	7.15	----	----	----	----	34.00
IV. Protein 20-15 per cent.											
Badger Dairy Feed	9.77	7.58	19.00	12.01	47.49	4.15	----	----	----	----	27.00
Wheat Middlings	10.74	4.39	17.52	5.76	56.44	5.15	13.5	1.7	44.0	4.5	29.94
Wheat Mixed Feed	10.60	5.35	16.76	7.12	55.44	4.73	13.1	4.4	42.6	4.1	30.00

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE—*Continued.*

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract (Starch, etc.).	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Buckwheat Feed	10.09	3.58	16.31	25.07	40.79	4.16	----	----	----	----	$26.00
Quaker Molasses Dairy Feed	8.98	6.02	16.25	12.75	53.02	2.98	----	----	----	----	28.00
Sugarota Dairy Feed	9.33	7.97	15.94	18.24	42.71	5.81	----	----	----	----	27.70
Wheat Bran	10.10	6.67	15.86	9.21	53.37	4.79	12.2	3.6	37.9	3.0	27.90
Daisy Dairy Feed	8.35	7.68	15.69	12.55	52.67	3.06	----	----	----	----	28.00
Sugarota Horse Feed	10.14	8.06	15.44	19.71	40.97	5.68	----	----	----	----	29.00
Rye Middlings	11.95	3.06	15.34	3.43	63.25	2.97	----	----	----	----	30.50
Electric Stock Feed	9.78	6.78	15.31	9.55	56.20	2.38	----	----	----	----	27.00
V. Protein 15-10 per cent.											
Rye Feed	11.69	3.12	14.44	2.99	64.76	3.00	11.6	----	57.0	2.7	30.00
Badger Stock Feed	10.54	6.58	13.31	14.89	51.38	3.30	----	----	----	----	32.00
Alfalfa Stock Feed	10.94	5.31	12.12	11.68	57.13	2.82	----	----	----	----	34.00
Derby Stock Feed	8.65	3.61	12.00	10.79	58.46	6.49	----	----	----	----	32.00
Algrane Horse Feed	10.73	4.13	11.94	10.08	59.02	4.10	----	----	----	----	34.00
Buffalo Horse Feed	10.05	3.46	11.50	8.75	61.71	4.53	----	----	----	----	33.00
Schumacher's Stock Feed	9.42	4.15	11.50	10.96	59.15	4.82	----	----	----	----	33.00
Wheat and Corn Cob Feed	10.09	4.18	11.39	15.33	55.94	3.07	7.2	4.3	39.7	2.8	26.67
Sterling Stock Feed	9.57	4.82	11.25	8.00	61.12	5.24	----	----	----	----	30.00
Economy Feed	8.53	3.24	11.25	14.08	56.77	6.13	----	----	----	----	30.00
Molac Molasses Horse Feed	10.09	5.73	10.88	11.69	59.24	2.37	----	----	----	----	25.00
Hominy Feed	9.97	2.73	10.70	4.36	63.78	8.46	7.0	2.9	56.8	7.8	31.42
Wirthmore Stock Feed	7.86	4.09	10.50	8.91	61.24	7.40	----	----	----	----	32.00
VI. Protein under 10 per cent.											
Haskell Stock Feed	8.47	3.03	9.94	6.02	64.38	8.16	----	----	----	----	32.00
Sucrene Horse and Mule Feed	10.80	6.11	9.13	8.55	62.41	3.00	----	----	----	----	29.00
Star Feed	9.74	3.01	8.79	10.15	61.23	7.08	5.7	6.8	54.5	6.5	29.00
Buf-Ce-Co Stock Feed	9.53	2.74	8.75	8.41	65.37	5.20	----	----	----	----	31.00
Corn and Oats Feeds	9.28	3.90	8.53	12.44	62.08	3.77	6.1	6.0	51.5	3.3	30.20
Hexagon for Horses	9.18	4.34	8.50	13.76	58.73	5.49	----	----	----	----	32.00
New England Stock Feed	10.05	4.20	8.13	14.52	57.41	5.69	----	----	----	----	34.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	OIL SEED PRODUCTS. *Cotton Seed Meal.*	
23578	Choice. American Cotton Oil Co., Memphis, Tenn.	*Moosup:* T. E. Main & Son
23436	———. H. E. Bridges & Co., Memphis, Tenn.	*New Canaan:* C. H. Fairty
23531	Owl Brand. F. W. Brodé, Memphis, Tenn.	*Thompsonville:* H. K. Brainard
23511	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Middletown:* Meech & Stoddard Co.
23560	" " " " "	*Mystic:* Mystic Grain Co.
23557	———. *C. A. Conant, Boston, Mass.	*Westerly:* C. W. Campbell & Co.
23452	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Wallingford:* E. E. Hall
23509	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Waterbury:* D. L. Dickinson & Son
23547	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*New London:* Arnold Rudd Co.
23586	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Putnam:* Bosworth Bros.
23594	Prime. Hunter Bros. Milling Co., St. Louis, Mo.	*Willimantic:* H. A. Bugbee
23522	Choice Bolted. J. E. Soper & Co., Boston, Mass.	*Hartford:* L. C. Daniels Grain Co.
23528	———. * " " " "	*Hartford:* Smith, Northam & Co.
23591	Prime. " " " "	*Willimantic:* E. A. Buck & Co.
23582	Star Brand. *J. Lindsay Wells Co., Memphis, Tenn.	*Danielson:* Young Bros. Co.
		Average guaranty
		Average of these 15 analyses
		Average digestible
	Linseed Meal, New Process.	
23473	American Linseed Co., Chicago, Ill.	*New Haven:* Abner Hendee
23530	" " " "	*Unionville:* F. D. Lawton & Son
23592	" " " "	*Willimantic:* E. A. Buck & Co.
		Average guaranty
		Average of these 3 analyses
		Average digestible
	Linseed Meal, Old Process.	
23433	American Linseed Co., New York	*So. Norwalk:* Manuel T. Hatch
23480	" " " "	*Meriden:* Meriden Grain and Feed Co.
23562	Mann Bros. Co., Buffalo, N. Y.	*Groton:* Groton Grain Co.
23606	*Geo. B. Robinson, New York	*Winsted:* E. Manchester & Sons
		Average guaranty
		Average of these 4 analyses
		Average digestible
	WHEAT PRODUCTS. *Bran from Winter Wheat.*	
23418	Pennant Rich Bran. Allen Baker Comm. Co., St. Louis, Mo.	*Guilford:* Morse & Landon
23466	Gold Bond Bran. Central Mill. Co., Lyons, Kan.	*Branford:* S. V. Osborn
23607	Chapin & Co., St. Louis, Mo.	*Winsted:* E. Manchester & Sons

* Statement of dealer.

SAMPLED IN 1909.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23578	7.72	6.51	39.56	8.51	29.39	8.31	$34.00
23436	8.51	6.60	42.06	8.26	27.28	7.29	34.00
23531	7.14	7.38	41.69	7.50	27.88	8.41	35.00
23511	7.64	6.37	37.56	10.43	30.95	7.05	35.00
23560	7.25	6.58	41.56	6.83	30.02	7.76	35.00
23557	7.19	6.45	41.25	6.05	29.59	9.47	34.40
23452	8.31	5.67	41.00	8.29	28.94	7.79	33.00
23509	8.32	6.29	40.25	7.25	29.25	8.64	35.00
23547	9.13	5.69	38.63	9.23	30.02	7.30	35.00
23586	9.42	5.98	36.56	9.42	30.83	7.79	34.40
23594	7.39	5.93	40.00	7.67	30.11	8.90	34.00
23522	7.55	6.21	39.38	8.09	28.48	10.29	37.00
23528	9.27	6.23	38.00	8.03	31.18	7.29	38.00
23591	7.72	6.07	40.69	7.67	29.74	8.11	35.00
23582	9.19	6.20	39.31	8.27	29.18	7.85	34.00
----	----	----	**39.93**	----	----	**7.08**	
----	**8.12**	**6.28**	**39.83**	**8.10**	**29.52**	**8.15**	**34.85**
----	----	----	**33.5**	**2.8**	**23.0**	**7.7**	
23473	10.28	6.19	37.56	8.51	34.13	3.33	37.00
23530	10.10	6.33	37.31	7.94	35.15	3.17	38.00
23592	9.93	5.71	37.38	7.85	35.81	3.32	37.00
----	----	----	**36.00**	----	----	**1.00**	
----	**10.10**	**6.08**	**37.42**	**8.10**	**35.03**	**3.27**	**37.33**
----	----	----	**31.4**	**6.0**	**28.0**	**2.9**	
23433	10.20	4.93	36.56	7.39	35.45	5.47	38.00
23480	11.50	5.12	34.69	7.13	35.99	5.57	33.00
23562	9.02	5.03	36.63	6.02	36.30	7.00	37.00
23606	10.54	6.34	30.75	8.27	38.91	5.19	36.00
----	----	----	**32.00**	----	----	**5.50**	
----	**10.31**	**5.36**	**34.66**	**7.20**	**36.66**	**5.81**	**36.00**
----	----	----	**30.8**	**4.1**	**28.6**	**5.2**	
23418	10.29	6.65	16.75	8.32	53.67	4.32	29.00
23466	10.86	6.88	17.31	8.99	51.55	4.41	28.00
23607	10.57	6.87	19.25	7.90	50.70	4.71	27.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Bran from Winter Wheat.	
23446	Cumberland Mills, Nashville, Tenn.	*Danbury:* F. C. Benjamin & C
23590	Adrian Bran. Detroit Mill. Co., Detroit, Mich.	*Willimantic:* E. A. Buck & C
23437	Hecker-Jones-Jewell Mill. Co., New York	*New Canaan:* C. H. Fairty
23427	Hunter Bros. Mill. Co., St. Louis, Mo.	*Norwalk:* Holmes, Keeler Selleck Co.
23412	Hunter, Robinson, Wenz Mill Co., St. Louis, Mo.	*Guilford:* G. F. Walter
23561	Powerful Standard Bran. A. B. McCrillis & Son, Boston, Mass.	*Mystic:* J. L. Manning & Co.
23602	Seward City Mills, Seward, Neb.	*Winsted:* Platt & Co.
23500	Southwestern Mill Co., Kansas City, Mo.	*New Britain:* C. W. Lines Co
23612	Star and Crescent Milling Co., Chicago, Ill.	*Winsted:* F. W. Woodruff & So
23471	Stott's Bran. David Stott, Detroit, Mich.	*New Haven:* Abner Hendee
23584	Updike Milling Co., Omaha, Neb.	*Danielson:* Young Bros. Co.
23506	Vimco Bran. Valley City Mill Co., Grand Rapids, Mich	*Waterbury:* The Spencer Gra Co.
23527	Voigt's Bran. Voigt Milling Co., Grand Rapids, Mich	*Hartford:* Smith, Northam & C
		Average of these 16 analyses.
		Average digestible
	Bran from Spring Wheat.	
23419	Winona Bran. Bay State Mill. Co., Winona, Minn.	*Ansonia:* Ansonia Flour a Grain Co.
23576	Imperial Bran. Duluth Superior Mill. Co., Duluth, Minn.	*Plainfield:* A. C. Tillinghast
23580	Coarse Bran. Wm. G. Crocker, Minneapolis, Minn.	*Danielson:* Quinnebaug Gr Mill
23565	Lucky Bran. Federal Milling Co., Lockport, N. Y.	*Norwich:* Norwich Grain Co.
23595	Marshall Mill Co., Marshall, Minn.	*Colchester:* A. C. Case
23589	Seal of Minnesota Bran. New Prague Mill Co., New Prague, Minn.	*Willimantic:* E. A. Buck & C
23543	Northwestern Consol. Mill. Co., Minneapolis, Minn.	*Manchester:* Little & McKinn
23439	Pillsbury's Bran. Minneapolis, Minn.	*Danbury:* Keeler Grain Co.
23456	Sleepy Eye Milling Co., Sleepy Eye, Minn.	*New Haven:* R. G. Davis
23541	Fancy Bran. Geo. Tileston Mill Co., St. Cloud, Minn.	*Rockville:* Edward White
23573	Geo. Urban Milling Co., Buffalo, N. Y.	*Plainfield:* J. P. Kingsley & S
23488	Washburn-Crosby Co., Minneapolis, Minn.	*Southington:* Southington Lu ber and Feed Co.
		Average of these 12 analyses.
		Average digestible
	Bran, unclassified.	
23459	Anchor Bran. Kemper Mill and Elev. Co., Kansas City, Mo.	*New Haven:* R. G. Davis

SAMPLED IN 1909—*Continued.*

Station No.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
23446	10.18	6.40	16.00	8.14	54.16	5.12	$27.00
23590	10.03	6.00	15.75	7.99	56.06	4.17	27.00
23437	9.80	6.13	15.37	9.25	54.92	4.53	28.00
23427	10.12	6.20	16.44	8.56	54.14	4.54	28.00
23412	9.71	6.85	15.69	8.89	53.91	4.95	29.00
23561	9.56	7.05	14.63	10.06	53.76	4.94	27.00
23602	10.24	7.13	14.88	8.97	54.11	4.67	30.00
23500	10.48	7.21	15.75	9.71	52.68	4.17	27.00
23612	10.19	6.43	16.50	9.35	52.28	5.25	28.00
23471	12.01	6.93	15.81	7.80	52.78	4.67	27.00
23584	9.90	6.68	15.31	8.79	54.93	4.39	26.00
23506	10.07	5.94	16.19	8.00	54.82	4.98	29.00
23527	10.73	5.61	15.88	6.91	56.29	4.58	29.00
----	**10.30**	**6.56**	**16.09**	**8.60**	**53.80**	**4.65**	**27.88**
----	----	----	**12.4**	**3.3**	**38.2**	**2.9**	
23419	10.12	6.85	15.44	9.24	53.40	4.95	28.00
23576	9.57	6.40	15.38	9.97	53.64	5.04	28.00
23580	9.93	7.05	14.81	11.07	52.24	4.90	27.00
23565	10.67	6.68	16.38	10.05	50.78	5.44	27.00
23595	8.93	7.41	15.31	10.98	52.06	5.31	28.00
23589	9.23	7.37	15.00	10.43	52.68	5.29	26.00
23543	9.29	7.05	15.50	10.25	52.44	5.47	29.00
23439	10.05	6.65	15.75	10.39	52.22	4.94	30.00
23456	11.15	5.47	16.37	7.03	55.32	4.66	28.00
23541	8.16	7.23	15.13	11.21	52.90	5.37	28.00
23573	9.53	6.86	15.44	10.79	52.53	4.85	27.00
23488	10.24	6.40	15.13	10.38	52.47	5.38	30.00
----	**9.74**	**6.78**	**15.47**	**10.15**	**52.73**	**5.13**	**28.00**
----	----	----	**11.9**	**4.0**	**37.4**	**3.2**	
23459	11.10	7.20	16.87	7.82	52.56	4.45	27.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Middlings from Winter Wheat.	
23621	Liberty Fancy Middlings. Allen Baker Comm. Co., St. Louis, Mo.	*Thomaston*: L. E. Blackmer
23609	Ballard's Ship Stuff. Ballard & Ballard Co., Louisville, Ky.	*Winsted*: E. Manchester & Son
23444	Daisy Middlings. Daisy Roller Mill, Milwaukee, Wis.	*Danbury*: F. C. Benjamin & Co
23548	Apex Middlings. Detroit Mill. Co., Detroit, Mich.	*New London*: Arnold Rudd Cc
23426	Fancy White Middlings. Hecker-Jones-Jewell Mill. Co., New York	*Norwalk*: Holmes, Keeler & Selleck Co.
23465	"H" Middlings. Hecker-Jones-Jewell Mill. Co., New York	*Branford*: S. V. Osborn
23476	Hunter Bros. Mill Co., St. Louis, Mo.	*New Haven*: Abner Hendee
23413	Hunter, Robinson, Wenz Mill. Co., St. Louis, Mo.	*Guilford*: G. F. Walter
23587	Climax Middlings. David Stott, Detroit, Mich.	*Putnam*: Bosworth Bros.
23417	Vimco Middlings. Valley City Mill. Co., Grand Rapids, Mich.	*Guilford*: Morse & Landon
		Average of these 10 analyses
		Average digestible
	Middlings from Spring Wheat,	
23620	Flour Middlings. Bay State Mill. Co., Winona, Minn.	*Torrington*: D. L. Talcott
23552	Snowball Middlings. Seymour Carter, Hastings, Minn.	*New London*: Beebe & Bragaw
23535	No. 8 Middlings. Chapin & Co., Milwaukee, Wis.	*Suffield*: Spencer Bros.
23579	Standard Middlings. Wm. G. Crocker, Minneapolis, Minn.	*Danielson*: Quinnebaug Gris Mill
23608	Choice Middlings. Crystal Mill. Co., Lake Crystal, Minn	*Winsted*: E. Manchester & Son
23575	S. Middlings. Duluth Superior Mill. Co., Duluth, Minn.	*Plainfield*: A. C. Tillinghast
23596	Choice Middlings, Eagle Roller Mill Co., New Ulm, Minn.	*Colchester*: A. C. Case
23457	Ben Hur Middlings. Hennepin Mill Co., Minneapolis, Minn.	*New Haven*: R. G. Davis
23549	New Star Roller Mill Co., Wahpeton, So. Dak.	*New London*: P. Schwartz Co.
23442	Pillsbury's B Middlings, Minneapolis, Minn.	*Danbury*: Keeler Grain Co.
23491	Pillsbury's A Middlings, Minneapolis, Minn.	*Plainville*: F. B. Newton
23533	Pillsbury's Daisy Middlings, Minneapolis, Minn.	*Thompsonville*: H. K. Brainard
23619	Sleepy Eye Milling Co., Sleepy Eye, Minn.	*Torrington*: D. L. Talcott
23542	Fancy Middlings. Geo. Tileston Mill Co., St. Cloud, Minn.	*Rockville*: Edward White
23572	Geo. Urban Milling Co., Buffalo, N. Y.	*Plainfield*: J. P. Kingsley & Sor
23416	Standard Middlings. Washburn-Crosby Co., Minneapolis, Minn.	*Guilford*: Morse & Landon
		Average of these 16 analyses
		Average digestible

SAMPLED IN 1909—*Continued.*

Station No.	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Analyses.						
23621	10.33	4.12	17.88	4.22	58.01	5.44	$30.00
23609	10.75	4.86	17.75	5.36	56.57	4.71	28.00
23444	10.03	4.67	16.37	7.77	56.20	4.96	30.00
23548	10.35	4.14	16.75	5.52	58.12	5.12	30.00
23426	10.45	4.14	20.06	4.32	54.82	6.21	33.00
23465	11.15	5.40	17.12	7.49	53.57	5.27	29.00
23476	12.56	3.85	17.44	4.08	57.35	4.72	27.00
23413	11.22	4.03	17.44	4.35	58.05	4.91	32.00
23587	10.89	4.04	17.31	5.58	56.65	5.53	28.40
23417	11.23	3.99	16.06	4.41	59.35	4.96	30.00
----	**10.90**	**4.32**	**17.42**	**5.31**	**56.87**	**5.18**	**29.74**
----	----	----	**13.4**	**1.6**	**44.4**	**4.6**	
23620	11.87	3.86	18.63	4.18	56.28	5.18	31.00
23552	10.76	4.52	17.81	5.62	56.54	4.75	32.00
23535	11.08	4.07	18.50	5.54	55.19	5.62	33.00
23579	10.28	5.30	17.69	7.57	53.90	5.26	28.00
23608	11.38	4.82	17.19	6.73	54.68	5.20	28.00
23575	10.54	4.40	17.38	6.09	56.30	5.29	30.00
23596	9.80	5.11	17.13	8.51	53.67	5.78	28.00
23457	11.11	4.76	17.50	6.60	54.40	5.63	27.00
23549	10.54	3.98	16.25	6.05	57.43	5.75	28.00
23442	9.96	4.59	18.19	6.68	55.38	5.20	30.00
23491	10.54	3.81	18.69	4.70	57.03	5.23	33.00
23533	11.79	3.24	18.44	2.35	59.38	4.80	35.00
23619	9.82	4.98	16.75	6.72	58.90	2.83	30.00
23542	10.52	3.75	17.13	4.60	58.32	5.68	30.00
23572	10.35	4.17	17.44	5.98	57.14	4.92	28.00
23416	10.47	5.45	17.75	6.92	54.50	4.91	28.00
----	**10.68**	**4.43**	**17.65**	**5.93**	**56.19**	**5.12**	**29.94**
----	----	----	**13.6**	**1.8**	**43.8**	**4.5**	

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.* *Middlings, unclassified.*	
23501	*Colonial Middlings. Miner-Hilliard Mill. Co., Wilkesbarre, Pa.	*New Britain*: C. W. Lines (
23604	Occidental Flour Middlings	*Winsted*: Theo. Wachter
	Mixed Feed from Winter Wheat.	
23534	Acme Feed. Acme Evans Co., Indianapolis, Ind.	*Suffield*: Spencer Bros.
23597	Cream Feed. " " " "	*Colchester*: A. C. Case
23623	Apex Fancy. Allen Baker Comm. Co., St. Louis, Mo.	*Thomaston*: L. E. Blackmer.
23510	Bull's Eye. Blish Milling Co., Seymour, Ind.	*Derby*: Peterson-Hendee Co
23495	Hope Mills. J. Andrew Cain, Versailles, Ky.	*Bristol*: W. O. Goodsell
23611	Erie. Chapin & Co., St. Louis	*Winsted*: E. Manchester & S
23449	Harter's. The Harter Milling Co., Toledo, O.	*Wallingford*: E. E. Hall
23422	Manhattan. Hecker-Jones-Jewell Mill. Co., New York	*Ansonia*: Ansonia Flour Grain Co.
23593	Queen. Hecker-Jones-Jewell Mill. Co., New York	*Willimantic*: H. A. Bugbee.
23447	Sunshine. Hunter Bros. Mill. Co., St. Louis, Mo.	*Bethel*: Johnston & Morrisor
23524	Wildfire. Hunter, Robinson, Wenz Mill. Co., St. Louis, Mo.	*Hartford*: L. C. Daniels Gi Co.
23526	Illmo. Hunter, Robinson, Wenz Mill. Co., St. Louis, Mo.	*Hartford*: Smith, Northam Co.
23497	Snowflake. Lawrenceburg Mill Co., Lawrenceburg, Ind.	*Bristol*: Geo. W. Eaton Est.
23564	Millbourne. Millbourne Mills, Philadelphia, Pa.	*Norwich*: Norwich Grain Co
23616	Star and Crescent. Star and Crescent Mill. Co., Chicago, Ill.	*Torrington*: F. U. Wadhams Son
23584	Vimco. Valley City Mill. Co., Grand Rapids, Mich.	*Waterbury*: The Spencer Gr Co.
23492	Wagoner-Gates Mill Co., Independence, Mo.	*Plainville*: Geo. W. Eaton I
23481	Kent. Williams Bros. Co., Kent, O.	*Meriden*: Meriden Grain a Feed Co.
		Average of these 18 analyses
		Average digestible
	Mixed Feed from Spring Wheat.	
23618	Winona. Bay State Mill. Co., Winona, Minn.	*Torrington*: D. L. Talcott
23536	Vermont. Chapin & Co., Milwaukee, Wis.	*Suffield*: Spencer Bros.
23540	Rutland. " " " "	*Rockville*: Edward White
23415	Boston. Duluth Superior Mill. Co., Duluth, Minn.	*Guilford*: Morse & Landon
23626	Lucky. Federal Milling Co., Lockport, N. Y.	*New Milford*: F. R. Green
23588	Faylor's. Northwestern Elevator and Mill. Co., Toledo, O.	*Willimantic*: E. A. Buck & (

* See note on page 286.

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23501	10.27	3.29	12.56	6.10	61.08	6.70	$32.00
23604	10.01	4.51	16.50	7.60	56.09	5.29	32.00
23534	11.06	5.77	18.06	7.30	53.17	4.64	31.00
23597	11.26	5.16	17.75	6.56	55.08	4.19	30.00
23623	10.64	5.88	16.00	7.47	55.91	4.10	28.00
23510	10.40	5.95	17.38	7.39	54.42	4.46	29.00
23495	11.87	4.82	16.75	5.84	56.97	3.75	32.00
23611	10.14	6.15	16.88	7.58	54.02	5.23	29.00
23449	11.24	5.47	17.06	7.18	54.41	4.64	28.00
23422	11.18	5.35	15.56	7.99	54.99	4.93	29.00
23593	9.39	6.23	16.00	8.69	55.03	4.66	28.00
23447	10.85	5.66	17.44	7.38	54.40	4.27	30.00
23524	10.62	5.78	16.50	7.21	54.98	4.91	31.00
23526	10.68	5.30	16.69	7.29	55.44	4.60	31.00
23497	10.77	4.90	17.25	6.33	56.85	3.90	31.00
23564	9.39	4.99	15.88	5.49	59.79	4.46	31.00
23616	8.89	4.97	16.38	6.03	59.61	4.12	29.00
23504	10.62	5.37	16.00	7.27	55.79	4.95	31.00
23492	10.41	5.74	17.00	6.98	55.37	4.50	33.00
23481	11.41	5.04	16.37	6.54	56.04	4.60	31.00
	10.60	**5.47**	**16.72**	**7.03**	**55.68**	**4.50**	**30.11**
	----	----	**13.0**	**4.4**	**4.29**	**3.9**	
23618	11.17	6.04	17.00	9.31	51.23	5.25	29.00
23536	10.20	4.88	17.38	6.50	55.88	5.16	31.00
23540	10.63	5.05	15.94	8.30	54.59	5.49	30.00
23415	10.89	5.10	16.19	7.07	56.02	4.73	29.00
23626	10.08	5.94	17.19	7.87	53.97	4.95	30.00
23588	9.92	5.28	17.00	6.82	56.80	4.18	29.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Concluded.* *Mixed Feed from Spring Wheat.*	
23440	Fancy. Pillsbury, Minneapolis, Minn.	*Danbury:* Keeler Grain Co.
23455	Occident. Russell Miller Mill. Co., Minneapolis, Minn.	*New Haven:* R. G. Davis
23624	Regular. Russell Flour Co., Minneapolis, Minn.	*Canaan:* Ives & Pierce
23420	Gold Mine. Sheffield King Mill. Co., Minneapolis, Minn.	*Ansonia:* Ansonia Flour an Grain Co.
23599	Superior. Washburn-Crosby Co., Minneapolis, Minn.	*Colchester:* Colchester Grain an Coal Co.
		Average of these 11 analyses
		Average digestible
	Mixed Feed, unclassified.	
23518	Huron. Chapin & Co.	*E. Hartford:* G. M. White & Co
23499	*Columbia. C. M. Cox Co., Boston, Mass.	*New Britain:* C. W. Lines Co.
23617	Newton. C. M. Cox Co., Boston, Mass.	*Torrington:* D. L. Talcott
	Red Dog Flour.	
23517	*Fancy. Meech & Stoddard, Middletown	*Middletown:* Meech & Stoddar
	MAIZE PRODUCTS. *Gluten Feed.*	
23732	Atlantic. Atlantic Starch Works, Westport	Manufacturer
		Guaranty
		Digestible
23411	*†Buffalo. Corn Products Refining Co., Chicago, Ill.	*Guilford:* G. F. Walter
23441	†Buffalo. Corn Products Refining Co., Chicago, Ill.	*Danbury:* Keeler Grain Co.
23467	†Buffalo. Corn Products Refining Co., Chicago, Ill.	*Branford:* S. V. Osborn
23525	†Buffalo. Corn Products Refining Co., Chicago, Ill.	*Hartford:* Smith, Northam & Co.
		Average guaranty
		Average of these 4 analyses
		Average digestible
23502	†Cream of Corn. American Maize Products Co., New York	*New Britain:* Stanley-Svea Coa and Wood Co.
23544	Cream of Corn. American Maize Products Co., New York	*Manchester:* E. W. McKuhney
		Average guaranty
		Average of these 2 analyses
		Average digestible
23556	†Crescent. Corn Products Refining Co., New York	*Westerly:* C. W. Campbell & Co
		Guaranty
		Digestible

*Statement of Dealer. † Labeled "Colored."

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23440	10.48	4.57	17.81	5.79	56.39	4.96	$32.00
23455	11.77	4.99	17.12	7.60	53.27	5.25	29.00
23624	10.94	5.61	16.44	7.17	54.69	5.15	30.00
23420	9.94	5.21	17.37	6.99	55.54	4.95	30.00
23599	10.79	5.06	16.63	7.16	55.17	5.19	27.00
	10.62	**5.25**	**16.92**	**7.33**	**54.86**	**5.02**	**29.64**
	----	----	**13.2**	**4.5**	**42.2**	**4.4**	
23518	11.37	4.85	17.38	6.05	55.29	5.06	32.00
23499	10.24	5.03	15.19	7.88	56.31	5.35	31.00
23617	10.07	5.31	16.75	6.60	56.61	4.66	29.00
23517	11.81	2.43	17.88	1.44	62.06	4.38	34.00
23732	5.21	1.13	32.81	1.40	58.38	1.07	30.00
	----	----	**28.00**	----	----	**1.00**	
	----	----	**27.9**	**1.1**	**52.0**	**0.9**	
23411	10.47	6.18	27.00	6.38	46.17	3.80	30.00
23441	10.59	3.86	28.37	6.85	47.98	2.35	32.00
23467	9.35	3.93	24.81	7.04	51.31	3.56	31.00
23525	9.09	5.26	28.25	6.73	48.61	2.06	34.00
	----	----	**23.75**	----	----	**2.50**	
	9.88	**4.81**	**27.11**	**6.75**	**48.51**	**2.94**	**31.75**
	----	----	**23.0**	**5.1**	**43.2**	**2.4**	
23502	9.33	1.98	29.31	6.44	50.44	2.50	32.00
23544	7.81	2.77	26.19	8.00	51.81	3.42	32.00
	----	----	**22.50**	----	----	**3.00**	
	8.57	**2.38**	**27.75**	**7.22**	**51.12**	**2.96**	**32.00**
	----	----	**23.6**	**5.5**	**45.5**	**2.5**	
23556	9.44	5.12	27.63	6.75	49.55	1.51	31.40
	----	----	**24.00**	**8.50**	----	**2.50**	
	----	----	**23.5**	**5.1**	**44.1**	**1.3**	

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MAIZE PRODUCTS—*Continued.* *Gluten Feed.*	
23407	Clinton. Clinton Sugar Refining Co., Clinton, Ia.	*Bridgeport:* Standard Feed Co
23559	" " " " " "	*Mystic:* Mystic Grain Co.
		Average guaranty
		Average of these 2 analyses
		Average digestible
23424	†Globe. Corn Products Refining Co., New York and Chicago, Ill.	*Norwalk:* Holmes, Keeler, Selleck Co.
23468	†Globe. Corn Products Refining Co., New York and Chicago, Ill.	*New Haven:* Abner Hendee
23730	†Globe. Corn Products Refining Co., New York and Chicago, Ill.	*Middlefield:* A. E. Miller
		Average guaranty
		Average of these 3 analyses
		Average digestible
23601	*Jenks. Huron Milling Co., Harbor Beach, Mich.	*Winsted:* Platt & Coe
		Guaranty.
		Digestible.
23545	K. K. K. J. C. Hubinger Bros. Co., Keokuk, Ia.	*Manchester:* E. W. McKuhney
		Guaranty
		Digestible
23405	New England. J. E. Soper & Co., Boston, Mass.	*Bridgeport:* Berkshire Mills
		Guaranty
		Digestible
		Average guaranty of all gluten feeds
		Average of all (16) analyses
		Average digestible
	Hominy Feed.	
23438	Purity. American Rice and Cereal Co., Keokuk, Ia.	*Danbury:* Keeler Grain Co.
		Guaranty
23729	‡M. F. Baringer, Philadelphia, Pa.	*Middlefield:* A. E. Miller
		Guaranty
23409	Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb
23425	" " " " "	*Norwalk:* Holmes Keeler & Selleck Co.
23482	" " " " "	*Meriden:* Meriden Grain and Feed Co.
		Average guaranty
		Average of these 3 analyses
23553	‡Niagara. Chapin & Co., Boston, Mass.	*New London:* E. Calkins
23574	" " " " "	*Plainfield:* J. P. Kingsley & Co.
		Average guaranty
		Average of these 2 analyses
23490	‡Wirthmore. C. M. Cox, Boston, Mass.	*Plainville:* F. B. Newton
		Guaranty
23577	Lenox. R. J. Hardy & Sons, Boston, Mass.	*Moosup:* T. E. Main & Son
		Guaranty
23539	Hunter Bros. Mill Co., St. Louis, Mo.	*Rockville:* Rockville Milling Co.
23546	" " " " " " "	*So. Manchester:* Geo. W. Straut
		Average guaranty
		Average of these 2 analyses

* Old stock. † Labeled "Colored."
‡ Statement of Dealer.

SAMPLED IN 1909—*Continued.*

Station No.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
407	10.19	1.02	22.37	6.96	54.53	4.93	$33.00
559	9.81	0.87	22.88	6.35	56.75	3.34	32.00
	----	----	**23.00**	----	----	**3.00**	
	10.00	**0.95**	**22.63**	**6.65**	**55.63**	**4.14**	**32.00**
	----	----	**19.2**	**5.1**	**49.5**	**3.4**	
424	9.79	4.69	26.81	7.58	49.21	1.92	33.00
468	9.58	3.81	27.75	7.71	47.90	3.25	32.00
730	9.46	2.87	27.19	7.60	50.39	2.49	31.00
	----	----	**24.00**	----	----	**2.50**	
	9.61	**3.79**	**27.25**	**7.63**	**49.17**	**2.55**	32.00
	----	----	**23.2**	**5.8**	**43.8**	**2.1**	
501	8.61	0.80	26.50	6.12	48.85	9.12	34.00
	----	----	**27.00**	**4.50**	----	**7.50**	
	----	----	**22.5**	**4.7**	**43.5**	**7.6**	
545	7.55	1.53	24.81	7.98	53.72	4.41	32.00
	----	----	**23.00**	----	----	**2.30**	
	----	----	**21.1**	**6.1**	**47.8**	**3.7**	
405	9.00	1.00	24.94	7.39	54.16	3.51	34.00
	----	----	**24.00**	----	----	**3.00**	
	----	----	**21.2**	**5.6**	**48.2**	**2.9**	
	----	----	**24.00**	----	----	**2.86**	
	9.08	**2.93**	**26.73**	**6.70**	**51.23**	**3.33**	**32.02**
	----	----	**22.7**	**5.1**	**45.6**	**2.8**	
438	8.39	2.90	10.87	4.02	65.13	8.69	32.00
	----	----	**10.00**	----	----	**7.34**	
729	6.19	2.71	10.94	4.43	67.41	8.32	28.00
	----	----	**10.00**	----	----	**7.00**	
409	11.75	2.47	10.37	3.68	63.87	7.86	33.00
425	11.28	2.72	10.31	4.29	62.74	8.66	33.00
482	10.95	2.35	10.19	3.57	65.20	7.74	33.00
	----	----	**10.25**	----	----	**8.00**	
	11.33	**2.51**	**10.29**	**3.85**	**63.93**	**8.09**	33.00
553	10.24	3.07	10.56	4.10	63.67	8.36	29.00
574	10.86	2.65	10.81	4.34	63.73	7.61	29.00
	----	----	**10.00**	----	----	**7.00**	
	10.55	**2.86**	**10.69**	**4.22**	**63.69**	**7.99**	**29.00**
590	10.63	2.65	10.63	4.47	63.55	8.07	33.00
	----	----	**9.00**	----	----	**7.00**	
77	10.51	2.59	11.00	4.34	63.31	8.25	31.00
	----	----	**10.00**	----	----	**7.50**	
39	10.93	3.00	10.75	6.16	60.07	9.09	32.00
46	9.42	3.14	10.50	6.85	60.91	9.18	33.00
	----	----	**8.50**	**10.00**	---	**7.00**	
	10.17	**3.07**	**10.63**	**6.50**	**60.49**	**9.14**	**32.50**

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MAIZE PRODUCTS—*Concluded.* *Hominy Feed.*	
23472	*Husted Milling Co., Buffalo, N. Y.	*New Haven:* Abner Hendee
		Guaranty
23434	Steam-Cooked. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*So. Norwalk:* Manuel T. Hat
23450	Steam-Cooked. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*Wallingford:* E. E. Hall
23498	Steam-Cooked. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*Bristol:* Geo. W. Eaton Est.
23554	Steam-Cooked. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*Westerly:* C. W. Campbell Co.
		Average guaranty
		Average of these 4 analyses
23460	Wm. H. Payne & Son, New York	*New Haven:* R. G. Davis
23485	" " " "	*Meriden:* August Grulich
		Average guaranty
		Average of these 2 analyses
23520	Blue Ribbon. J. E. Soper & Co., Boston, Mass.	*E. Hartford:* G. M. White Co.
		Guaranty
		Average guaranty of all homi feeds
		Average of all (19) analyses
		Average digestible
23566	Star Feed. Toledo Elevator Co., Toledo, O.	*Norwich:* Chas. Slosberg
23583	" " " " " " "	*Danielson:* Young Bros. Co.
23731	" " A. B. Porter & Co., Philadelphia, Pa.	*Middlefield:* C. N. Burnham
		Average guaranty
		Average of these 3 analyses
		Average digestible
23443	Corn Feed Meal. Quaker Oats Co., Chicago, Ill.	*Danbury:* F. C. Benjamin & C
		Guaranty
		Digestible
23493	Corn Screenings	*Bristol:* W. O. Goodsell
	RYE PRODUCTS.	
23515	Rye Feed. Boutwell Mill. & Grain Co., Troy, N. Y.	*Middletown:* Meech & Stodda
23529	Rye Feed. *H. D. Stone Mill. Co., Rochester, N. Y.	*Unionville:* F. D. Lawton & S
23423	Rye Middlings. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*Ansonia:* Ansonia Flour & Gra Co.
23451	Rye Middlings. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*Wallingford:* E. E. Hall
	BUCKWHEAT PRODUCTS.	
23483	Buckwheat Feed. Dayton Milling Co., Towanda, Pa.	*Meriden:* Meriden Grain a Feed Co.
23581	Buckwheat Middlings. Quinebaug Grist Mill, Danielson	*Danielson:* Quinebaug Grist M

* Statement of Dealer.

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23472	9.30	2.77	10.31	3.82	64.86	8.94	$33.00
	----	----	**10.14**	----	----	**7.02**	----
23434	9.72	2.69	10.87	3.30	64.86	8.56	33.00
23450	9.67	2.81	10.94	4.51	62.99	9.08	29.00
23498	9.20	2.77	11.13	4.89	62.99	9.02	33.00
23554	9.65	2.58	10.75	4.25	64.19	8.58	29.40
	----	----	**10.00**	**3.00**	----	**7.50**	----
	9.56	**2.71**	**10.92**	**4.24**	**63.76**	**8.81**	**31.10**
23460	10.02	2.51	10.81	3.80	64.86	8.00	31.00
23485	9.91	2.63	11.06	3.82	64.22	8.36	31.00
	----	----	**11.49**	----	----	**8.00**	----
	9.96	**2.57**	**10.94**	**3.81**	**64.54**	**8.18**	**31.00**
23520	10.74	2.89	10.50	4.25	63.35	8.27	32.00
	----	----	**10.00**	----	----	**8.00**	----
	----	----	**9.99**	----	----	**7.47**	----
	9.97	**2.73**	**10.70**	**4.36**	**63.78**	**8.46**	**31.42**
	----	----	**7.0**	**2.9**	**56.8**	**7.8**	----
23566	10.22	2.90	8.75	9.83	61.24	7.06	31.00
23583	9.35	3.15	8.88	10.68	60.78	7.16	29.00
23731	9.64	2.97	8.75	9.93	61.68	7.03	27.00
	----	----	**7.00**	**10.00**	----	**5.50**	----
	9.74	**3.01**	**8.79**	**10.15**	**61.23**	**7.08**	**29.00**
	----	----	**5.7**	**6.8**	**54.5**	**6.5**	----
23443	10.38	2.55	11.19	3.65	63.68	8.55	32.00
	----	----	**9.00**	----	----	**4.00**	----
	----	----	**7.27**	**2.48**	**56.78**	**8.47**	----
23493	9.83	1.37	9.56	10.09	66.23	2.92	20.00
23515	11.56	3.24	14.38	3.12	64.65	3.05	28.00
23529	11.83	3.00	14.50	2.86	64.86	2.95	32.00
23423	11.99	3.15	15.37	3.34	63.16	2.99	32.00
23451	11.92	2.97	15.31	3.52	63.34	2.94	29.00
23483	10.09	3.58	16.31	25.07	40.79	4.16	26.00
23581	12.21	4.83	32.13	8.88	33.59	8.36	32.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	BARLEY PRODUCTS.	
	Malt Sprouts.	
23570	Wm. Rahr & Sons, Manitowoc, Wis.	*Yantic:* A. R. Manning
		Guaranty
23474	Jersey. M. G. Rankin & Co., Milwaukee, Wis.	*New Haven:* Abner Hendee
		Guaranty
		Average of these 2 analyses
		Average digestible
	Dried Distillers' Grains.	
23523	Ajax Flakes. Ajax Mill. & Feed Co., Buffalo, N. Y.	*Hartford:* L. C. Daniels Gı Co.
23532	Ajax Flakes. Ajax Mill. & Feed Co., Buffalo, N. Y.	*Thompsonville:* H. K. Brain
		Average guaranty
		Average of these 2 analyses
		Average digestible
23516	*Connecticut Gluten	*Middletown:* Meech & Stodd
		Guaranty
		Digestible
23605	*Corn Distillers' Grains. A. B. Porter, Philadelphia, Pa.	*Winsted:* E. Manchester &
		Guaranty
		Digestible
	Dried Brewers' Grains.	
23538	Anheuser-Busch Brew. Asso., St. Louis, Mo.	*Suffield:* Arthur Sikes
		Guaranty
23428	Farmer's Feed Co., New York	*Norwalk:* Holmes, Keeler Selleck Co.
		Guaranty
23571	Schlitz Brewing Co., Milwaukee, Wis.	*Yantic:* A. R. Manning
		Guaranty
		Average guaranty of all samp
		Average of these 3 analyses
		Average digestible
	MIXED FEEDS.	
	Corn and Oat Feeds and Oat Feeds.	
23614	Corn and Oats. Buffalo Cereal Co., Buffalo, N.Y.	*Torrington:* F. U. Wadhams Son
		Guaranty
23558	Provender	*Westerly:* C. W. Campbell &
		Guaranty
23598	Oat Feed. Chas. M. Cox Co., Boston, Mass.	*Colchester:* Colchester Grain Coal Co.
		Guaranty
23461	Boss Chop Feed. Great Western Cereal Co., Chicago, Ill.	*New Haven:* R. G. Davis
		Guaranty
23478	De-Fi Corn and Oat Feed. The H. O. Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen
		Guaranty

* Statement of Dealer.

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23570	9.69	5.33	28.69	8.10	46.41	1.78	$30.00
	----	----	25.00	11.00	----	2.00	----
23474	10.14	5.93	25.50	12.67	44.38	1.38	25.00
	----	----	25.00	----	----	2.00	----
	9.91	5.63	27.10	10.38	45.40	1.58	27.50
	----	----	21.7	3.5	31.3	1.6	----
23523	5.39	3.75	29.94	9.83	38.44	12.65	34.00
23532	5.63	1.64	30.56	11.90	36.61	13.66	34.00
	----	----	31.00	----	----	12.00	----
	5.51	2.70	30.25	10.86	37.52	13.16	34.00
	----	----	22.1	10.3	30.4	12.5	----
23516	8.16	4.01	26.25	8.58	41.23	11.77	32.00
	----	----	30.00	----	----	15.00	----
	----	----	19.7	8.2	33.4	11.2	----
23605	6.47	1.80	27.63	14.70	36.11	13.29	30.40
	----	----	24.00	----	----	----	----
	----	----	20.2	14.00	29.2	12.6	----
23538	9.00	3.20	26.88	14.14	39.29	7.49	30.00
	----	----	24.00	----	----	7.50	----
23428	7.48	3.21	28.06	11.98	41.71	7.56	28.00
	----	----	26.30	----	----	7.60	----
23571	8.05	3.26	28.19	13.84	40.95	5.71	30.00
	----	----	24.50	----	----	6.50	----
	----	----	24.93	----		7.20	----
	8.18	3.22	27.71	13.32	40.65	6.92	29.33
	----	----	22.4	6.5	23.2	6.1	----
23614	10.97	2.09	10.38	5.44	66.03	5.09	34.00
	----	----	10.00	----	----	5.00	----
23558	11.35	2.04	9.56	3.75	69.50	3.80	33.00
	----	----	11.00	----	----	4.00	----
23598	7.26	6.21	5.06	25.92	52.89	2.66	26.00
	----	----	6.00	----	----	2.00	----
23461	9.09	5.21	9.69	7.68	62.62	5.71	28.00
	----	----	8.00	11.00	----	3.50	----
23478	8.34	4.56	7.50	16.72	59.64	3.24	32.00
	----	----	8.00	21.00	---	3.00	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS—*Continued.* *Corn and Oat Feeds and Oat Feeds.*	
23414	Jim Dandy Feed. The H. O. Co., Buffalo, N. Y.	*Guilford:* Morse & Landon
		Guaranty
23625	Corn and Oats. Husted Milling Co., Buffalo, N. Y.	*New Milford:* Ackley, Hatch & Marsh
		Guaranty
23512	Korn-Oato. Meech & Stoddard, Middletown	*Middletown:* Meech & Stoddard
23563	* " " " "	*Groton:* Groton Grain Co.
		Guaranty
		Average of these 2 analyses
23470	Victor Feed. Quaker Oats Co., Chicago, Ill.	*New Haven:* Abner Hendee
		Guaranty
		Average of all Corn and Oat Feeds (10)
		Average digestible
	Wheat and Corn Cob Feeds.	
23486	Jersey Mixed Feed. Indiana Mill. Co., Terre Haute, Ind.	*Meriden:* August Grulich
		Guaranty
23458	Blue Grass Mixed Feed. A. Waller & Co., Henderson, Ky.	*New Haven:* R. G. Davis
23567	Blue Grass Mixed Feed. A. Waller & Co., Henderson, Ky.	*Norwich:* Chas. Slosberg
		Guaranty
		Average of these 2 analyses
		Average of all (3) Wheat and Corn Cob Feeds
		Average digestible
	Proprietary Horse Feeds.	
23550	Molac Molasses Horse Feed. American Cereal Co., Chicago, Ill.	*New London:* P. Schwartz Co.
		Guaranty
23521	Hexagon for Horses. American Hominy Co., New York	*Hartford:* L. C. Daniels Grain Co.
		Guaranty
23622	Sucrena Horse and Mule Feed. American Milling Co., Chicago, Ill.	*Thomaston:* L. E. Blackmer
		Guaranty
23513	"Ubiko" Horse Feed. The J. W. Biles Co., Cincinnati, O.	*Middletown:* Meech & Stoddard
		Guaranty
23410	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb
		Guaranty
23430	Bonnie Horse Feed	*So. Norwalk:* Manuel T. Hatch
		Guaranty
23475	Algrane Horse Feed. The H. O. Co., Buffalo, N. Y.	*New Haven:* Abner Hendee
		Guaranty
23514	Sugaroto Horse Feed. North West Mills Co., Winona, Minn.	*Middletown:* Meech & Stoddard
		Guaranty

* Statement of Dealer.

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23414	7.31	5.64	7.56	23.06	53.84	2.57	$24.00
	----	----	7.50	----	----	2.75	----
23625	10.97	2.53	10.38	5.58	65.79	4.75	34.00
	----	----	9.00	----	----	3.00	----
23512	9.19	3.45	7.31	13.71	63.87	2.47	29.00
23563	8.51	3.61	7.06	12.86	65.67	2.29	33.00
	----	----	7.00	----	----	3.00	----
	8.85	**3.53**	**7.19**	**13.28**	**64.77**	**2.38**	**31.00**
23470	9.83	3.67	8.75	11.63	61.01	5.11	29.00
	----	----	7.50	12.00	----	3.00	----
	9.28	**3.90**	**8.53**	**12.44**	**62.08**	**3.77**	**30.20**
	----	----	6.1	6.0	51.5	3.3	----
23486	9.89	4.32	11.62	15.32	56.02	2.83	25.00
	----	----	10.00	----	----	2.50	----
23458	10.53	4.02	11.31	14.51	56.28	3.35	25.00
23567	9.86	4.20	11.25	16.17	55.50	3.02	30.00
	----	----	9.00	----	----	2.00	----
	10.19	**4.11**	**11.28**	**15.34**	**55.89**	**3.19**	**27.50**
	10.09	**4.18**	**11.39**	**15.33**	**55.94**	**3.07**	**26.67**
	----	----	7.2	4.3	39.7	2.8	----
23550	10.09	5.73	10.88	11.69	59.24	2.37	25.00
	----	----	----	----	----	----	----
23521	9.18	4.34	8.50	13.76	58.73	5.49	32.00
	----	----	6.00	10.00	----	5.00	----
23622	10.80	6.11	9.13	8.55	62.41	3.00	29.00
	----	----	10.00	----	----	3.50	----
23513	8.45	3.64	20.38	9.34	51.04	7.15	34.00
	----	----	16.00	----	----	6.00	----
23410	10.05	3.46	11.50	8.75	61.71	4.53	33.00
	----	----	10.00	----	----	4.00	----
23430	10.34	2.83	11.44	8.45	63.39	3.55	33.00
	----	----	14.12	5.53	----	4.15	----
23475	10.73	4.13	11.94	10.08	59.02	4.10	34.00
	----	----	12.00	----	----	4.50	----
23514	10.14	8.06	15.44	19.71	40.97	5.68	29.00
	----	----	12.00	----	----	2.50	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEED—*Continued.* *Proprietary Dairy and Stock Feeds.*	
23615	Sucrene Dairy Feed. American Milling Co., Chicago, Ill.	*Torrington:* F. U. Wadhams & Son
		Guaranty
23448	Unicorn Dairy Ration. Ajax Mill and Feed Co., Buffalo, N. Y.	*Bethel:* Johnson & Morrison
23454	Unicorn Dairy Ration. Ajax Mill and Feed Co., Buffalo, N. Y.	*New Haven:* R. G. Davis
		Guaranty
		Average of these 2 analyses
23487	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Southington:* Southington Lumber & Feed Co.
23507	Union Grains, Ready Ration. The J. W. Biles Co., Buffalo, N. Y.	*Waterbury:* D. L. Dickinson & Son
23569	Union Grains, Ready Ration. The J. W. Biles Co., Buffalo, N. Y.	*Yantic:* A. R. Manning
		Guaranty
		Average of these 3 analyses
23453	Calf Meal. Blatchford's Calf Meal Fact., Waukegan, Ill.	*Wallingford:* E. E. Hall
		Guaranty
23479	Creamery Feed. Buffalo Cereal Co, Buffalo, N. Y.	*Meriden:* Meriden Grain & Feed Co.
		Guaranty
23613	Buf-Ce-Co. Stock Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Torrington:* F. U. Wadhams & Son
		Guaranty
23551	Wirthmore Stock Feed. C. M. Cox Co., Boston, Mass.	*New London:* Beebee & Bragaw
		Guaranty
23445	Daisy Dairy Feed. Great Western Cereal Co., Chicago, Ill.	*Danbury:* F. C. Benjamin & Co.
		Guaranty
23408	Sterling Stock Feed. Great Western Cereal Co., Chicago, Ill.	*Stamford:* Scofield & Miller
		Guaranty
23568	Stock Feed. W. H. Haskell, Toledo, O.	*Norwich:* Chas. Slosberg
		Guaranty
23431	Bonnie Dairy Feed	*So. Norwalk:* Manuel T. Hatch
		Guaranty
23489	New England Stock Feed. The H. O. Co., Buffalo, N. Y.	*Southington:* Southington Lumber & Feed Co.
		Guaranty
23462	Badger Dairy Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*New Haven:* R. G. Davis
		Guaranty
23537	Badger Stock Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	*Suffield:* Arthur Sikes
		Guaranty
23610	Electric Stock Food. Milwaukee Grains and Feed Co., Milwaukee, Wis.	*Winsted:* E. Manchester & Sons
		Guaranty
23484	Sugarota Dairy Feed. North West Mills Co., Winona, Minn.	*Meriden:* August Grulich

SAMPLED IN 1909—*Continued.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
3615	9.17	8.21	16.75	10.26	50.88	4.73	$28.00
	----	----	**16.50**	----	----	**3.50**	
3448	8.52	3.12	26.50	8.60	45.59	7.67	33.00
3454	9.59	2.79	25.37	9.11	45.89	7.25	33.00
	----	----	**26.00**	**9.00**	----	**6.00**	
	9.05	**2.96**	**25.94**	**8.86**	**45.73**	**7.46**	**33.00**
3487	9.71	4.78	24.31	9.50	43.84	7.86	33.00
3507	8.71	4.97	23.94	9.61	44.69	8.08	34.00
3569	9.17	5.64	24.25	8.78	44.13	8.03	33.00
	----	----	**24.00**	**7.00**	----	**7.00**	
	9.20	**5.13**	**24.17**	**9.30**	**44.21**	**7.99**	**33.33**
3453	9.91	4.82	27.75	5.92	46.40	5.20	70.00
	----	----	**25.00**	----	----	**5.00**	
3479	9.35	4.34	20.50	9.62	50.05	6.14	32.00
	----	----	**18.00**	----	----	**4.00**	
3613	9.53	2.74	8.75	8.41	65.37	5.20	31.00
	----	----	**8.00**	----	----	**4.00**	
3551	7.86	4.09	10.50	8.91	61.24	7.40	32.00
	----	----	**9.00**	----	----	**4.00**	
3445	8.35	7.68	15.69	12.55	52.67	3.06	28.00
	----	----	**14.00**	----	----	**3.00**	
3408	9.57	4.82	11.25	8.00	61.12	5.24	30.00
	----	----	**10.00**	**9.00**	----	**4.00**	
3568	8.47	3.03	9.94	6.02	64.38	8.16	32.00
	----	----	**8.00**	**6.00**	----	**4.00**	
3431	10.80	3.35	21.06	7.05	53.16	4.58	33.00
	----	----	**15.87**	----	----	**5.53**	
3489	10.05	4.20	8.13	14.52	57.41	5.69	34.00
	----	----	**9.00**	**12.00**	----	**4.00**	
3462	9.77	7.58	19.00	12.01	47.49	4.15	27.00
	----	----	**16.00**	**12.00**	----	**3.50**	
3537	10.54	6.58	13.31	14.89	51.38	3.30	32.00
	----	----	**10.00**	**12.00**	----	**4.00**	
3610	9.78	6.78	15.31	9.55	56.20	2.38	27.00
	----	----	**12.00**	**10.00**	----	**2.00**	
3484	9.46	8.00	16.87	18.67	42.13	4.87	28.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEED—*Concluded.* *Proprietary Dairy and Stock Feeds.*	
23555	Sugarota Dairy Feed. North West Mills Co., Winona, Minn.	*Westerly:* C. W. Campbell & Cc
		Average guaranty
		Average of these 2 analyses
23494	Quaker Molasses Dairy Feed. Quaker Oats Co., Chicago, Ill.	*Bristol:* W. O. Goodsell
		Guaranty
23406	Schumacher's Stock Feed. Quaker Oats Co., Chicago, Ill.	*Bridgeport:* Berkshire Mills
		Guaranty
23503	Schumacher's Calf Meal. Quaker Oats Co., Chicago, Ill.	*New Britain:* Stanley Svea Coa and Wood Co.
		Guaranty
23603	Derby Stock Feed. Tioga Mill. and Elev. Co., Waverly, N. Y.	*Winsted:* Theo. Wachter
		Guaranty
23508	Economy Feed. Tioga Mill. and Elev. Co., Waverly, N. Y.	*Waterbury:* D. L. Dickinson & Son
		Guaranty
23435	Alfalfa Stock Feed. Otto Weiss, Wichita, Kans.	*New Canaan:* C. H. Fairty
		Guaranty
	Proprietary Poultry Feeds.	
23421	Poultry Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Ansonia:* Ansonia Flour & Grair Co.
		Guaranty
23477	Queen Poultry Mash. The Albert Dickinson Co., Chicago, Ill.	*Meriden:* A. H. Cashen
		Guaranty
23429	G. W. Alfalfa Meal. Great Western Cereal Co., Chicago, Ill.	*Norwalk:* Holmes, Keeler & Sel leck Co.
		Guaranty
23432	Bonnie Poultry Feed	*So. Norwalk:* Manuel T. Hatch
		Guaranty
23469	Poultry Feed. The H. O. Co., Buffalo, N. Y.	*New Haven:* Abner Hendee
		Guaranty
23505	Dry Mash Feed. Park & Pollard Co., Boston, Mass.	*Waterbury:* The Spencer Grair Co.
		Guaranty
23519	Growing Feed. Park & Pollard Co., Boston, Mass.	*E. Hartford:* G. M. White & Co
		Guaranty
23463	Lucerne Pure Ground Alfalfa. M. C. Peters Mill. Co., Omaha, Neb.	*New Haven:* R. G. Davis
		Guaranty
23600	Purina Mill Feed Mash. Purina Mills, St. Louis, Mo.	*New Haven:* J. T. Benham Est.
		Guaranty
23496	American Poultry Feed. Quaker Oats Co., Chicago, Ill.	*Bristol:* W. O. Goodsell
		Guaranty
23585	Every Morning Mash Feed. Ross Bros. Co., Worcester	*Putnam:* F. M. Cole
		Guaranty

SAMPLED IN 1909—*Concluded.*

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
23555	9.21	7.94	15.00	17.82	43.29	6.74	$27.40
	----	----	**18.00**	----	----	**4.75**	
	9.33	**7.97**	**15.94**	**18.24**	**42.71**	**5.81**	**27.70**
23494	8.98	6.02	16.25	12.75	53.02	2.98	28.00
	----	----	----	----	----	----	
23406	9.42	4.15	11.50	10.96	59.15	4.82	33.00
	----	----	**10.00**	----	----	**4.00**	
23503	9.31	3.11	18.13	3.49	57.57	8.39	65.00
	----	----	**19.00**	----	----	**8.00**	
23603	8.65	3.61	12.00	10.79	58.46	6.49	32.00
	----	----	**10.50**	**13.00**	----	**7.00**	
23508	8.53	3.24	11.25	14.08	56.77	6.13	30.00
	----	----	**10.00**	----	----	**5.00**	
23435	10.94	5.31	12.12	11.68	57.13	2.82	34.00
	----	----	**12.00**	----	----	**3.00**	
23421	10.79	2.89	16.12	4.82	59.82	5.56	38.00
	----	----	**15.00**	----	----	**4.00**	
23477	11.84	4.48	13.62	8.46	57.96	3.64	38.00
	----	----	**10.00**	----	----	**3.00**	
23429	8.68	8.78	14.87	29.09	36.48	2.10	38.00
	----	----	**14.00**	----	----	**2.00**	
23432	10.35	3.65	19.06	5.45	57.01	4.48	37.00
	----	----	**14.75**	----	----	**4.64**	
23469	11.26	3.54	17.62	5.62	57.14	4.82	36.00
	----	----	**17.00**	----	----	**5.50**	
23505	9.86	13.05	19.81	6.15	47.96	3.17	45.00
	----	----	**20.00**	----	----	**3.00**	
23519	12.16	3.59	14.56	3.07	62.73	3.89	44.00
	----	----	**14.00**	----	----	**3.00**	
23463	10.51	10.10	15.12	26.74	35.58	1.95	39.00
	----	----	**12.00**	----	----	----	
23600	10.35	4.87	16.31	8.69	57.50	2.28	40.00
	----	----	**17.00**	----	----	**5.00**	
23496	9.79	3.20	13.69	5.07	62.16	6.09	37.00
	----	----	**14.50**	----	----	**4.50**	
23585	9.92	8.91	19.63	10.29	45.80	5.45	40.00
	----	----	**12.00**	----	----	**3.50**	

Nutrients Purchasable for One Dollar.

	Protein.	Fiber and Nitrogen-free Extract.	Fat.
1. Feeds containing over 30 per cent. protein...	16.4	22.4	3.6
2. " " 25 to 30 " "	14.3	28.1	3.4
3. " " 20 to 25 " "	12.6	33.1	2.0
4. " " 15 to 20 " "	8.9	30.7	2.6
5. " " 10 to 15 " "	5.8	36.4	3.0
6. " " less than 10 per cent. protein	4.0	40.2	3.4

The variations in the amounts of digestible fat supplied in the different groups are comparatively small. The differences in the other two ingredients, however, are marked. Protein is by far the more expensive of these two, more than one-sixth of it being nitrogen, the element most generally lacking in our soils, most expensive to buy in fertilizers, and most necessary to "balance" the feed of our stock.

If the feeder is mainly concerned in getting protein for his grain feed, he certainly cannot afford to buy feeds of the last three groups containing less than 20 per cent. of protein. But even if he wishes to buy starchy food he can get more for the same money in group three than in four, and considering that he gets more than twice as much protein together with nearly the same amount of carbohydrates in group three as in groups five and six, the economy of buying these very low protein foods even for the starchy matter in them is more than doubtful.

PART IV.

NINTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

In the transmission of this my ninth annual report as state entomologist of Connecticut I have followed the custom of preceding years. The report covers the calendar year of 1909, except the financial statements, which are for the fiscal year ending September 30th, 1909.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1908, TO SEPTEMBER 30TH, 1909.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$3,000.00
Account of 1907, balance	779.47
Sale of duplicate pamphlet	.50
	$3,779.97

EXPENDITURES.

For field, office and laboratory assistance	$1,740.76
Printing and illustrations	55.15
Postage	53.62
Stationery	12.15
Telegraph and telephone	1.09
Express, freight and cartage	16.36

Library	$89.13	
Laboratory, apparatus and supplies	393.15	
Office supplies	15.26	
Traveling expenses	251.44	
Balance, cash on hand	1,151.86	
		$3,779.97

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$1,500.00
Account of 1908, balance	3.22
	$1,503.22

EXPENDITURES.

For salary of superintendent, and labor	$802.60	
Printing	1.60	
Tools and supplies	111.55	
Express, freight and cartage	30.61	
Traveling expenses	146.64	
Balance, cash on hand	410.22	
		$1,503.22

Memorandum:—This account of the state entomologist has been duly audited by the State Auditors of Public Accounts.

OFFICE FORCE AND FIELD ORGANIZATION.

Mr. B. H. Walden has continued as general assistant and Miss E. B. Whittlesey as stenographer, as in former years. Mr. G. H. Hollister, who has been in charge of the gypsy moth work at Stonington, on account of the success of that work in reducing the number of the insects was not needed for the whole season. After the scouting Mr. Hollister was employed by the H. L. Frost & Bartlett Company from February 1st until July 1st, when he worked at Stonington until August 20th, and then helped in the nursery inspection. On October 16th Mr. Hollister began his duties as forester of Keney Park, Hartford, where he has charge of pruning, planting, spraying and removing trees. We were, however, able to secure his services at Stonington in scouting work during the week ending December 18th. Mr. Hollister was also able to assist us at Wallingford the following week in destroying egg-masses of the gypsy moth, which had just been discovered there.

Mr. Arthur I. Bourne, A.B., a graduate of Dartmouth College, and a graduate student in entomology at the Massachuetts Agri-

cultural College at Amherst, was employed from June 23d to November 1st, most of the time working on aphids, but helping with the nursery inspection work when needed.

Lectures, Correspondence and Summary of Inspection Work.

During the calendar year of 1909, twenty-two lectures have been given before granges and other agricultural meetings and scientific societies. Fifteen of these were illustrated with lantern slides. Of inspections, forty-nine nurseries have been examined, forty-eight certificates granted, and thirty orchards, gardens and greenhouses have been examined for pests; 224 boxes and packages of imported nursery stock were inspected at their points of destination and fifty-two winter nests of the brown-tail moth found and destroyed; 249 samples of insects and their work received for identification; 1,514 letters and thirty-three packages relating to the work of this office have been sent out.

Exhibits.

The entomological department has taken part in five exhibits during the year. During the week ending September 18th the Station had an exhibit of its work at the State Fair at Berlin. Many cases of pinned insects were shown, as well as life history sets and Riker mounts of species which are especially injurious in Connecticut. Photographs and charts were also a part of the display, but what attracted the most attention and excited the most interest was about twenty jars and cages of living insects. These included mosquitoes (both *Anopheles,* the malarial kind, and *Culex,* the non-malarial ones) and several kinds of good-sized larvæ like tobacco worms, cecropia, io and tussock caterpillars, which could be obtained at that season of the year.

Several dozen Riker mounts of insects were shown in New York City early in October in connection with the general Station exhibit at the Jewish Farmers' Fair.

Special exhibits in Riker mounts were made in connection with the entomologists of the other New England States at the New England Fruit Show, held in Boston the middle of Octo-

ber, and at the meetings of the Entomological Society of America, also held in Boston the last week in December.

At the meeting of the State Board of Agriculture in New Haven the second week in December, a large exhibit was made by the Station, considerable material being furnished by the entomological department.

Publications from the Entomological Department, 1909.

Eighth Report of the State Entomologist (Part XI of the Station Report for 1907-08); 86 pages, 20 text figures, xviii plates. 9,000 copies, distributed in March, 1909.

Report of Committee on Injurious Insects, W. E. Britton, Chairman, read at the annual meeting, February 3, 1909. Report of the Connecticut Pomological Society, 1909, p. 24; 4 pages.

The San José Scale. *Connecticut Farmer,* April 10, 1909.

The Peach Sawfly. Correspondence slip, illustrated, reprinted in *Connecticut Farmer,* June 26, 1909.

Spraying Potatoes. Correspondence slip, illustrated, June, 1909.

Book Review, "Our Insect Friends and Enemies," by John B. Smith, Sc.D., Professor of Entomology in Rutgers College and Entomologist of the New Jersey Agricultural Experiment Station. *Science,* Vol. XXX, p. 283, Aug. 27, 1909.

Connecticut Laws Relating to the Suppression of Insect Pests, Plant Diseases, and Contagious Diseases of Bees. September, 1909.

Canker Worms. Correspondence slip, illustrated, October, 1909.

Bulletin 165. The San José Scale and Methods of Controlling It, by W. E. Britton. 24 pages, 13 figures. 11,000 copies. November, 1909.

The San José Scale. Correspondence slip, illustrated, November, 1909.

The Cocoons on the Sassafras Tree. *Guide to Nature,* December, 1909.

Gypsy Moth at Wallingford. *Connecticut Farmer,* December 25, 1909.

Inspection of Nurseries.

This work was commenced August 30th, and was nearly all finished before November 1st. It was done by Messrs. Walden, Hollister, Bourne and Britton.

The accompanying list of nurserymen contains forty-seven names as against forty last year. One nursery was inspected in the spring and forty-eight in the fall. One of these nurseries being attached, the owner could not carry out the treatment prescribed by the state entomologist, which was necessary in order to obtain the certificate. One firm had no stock to inspect, and was dropped from the list, and nine new

firms have started in the business. Two of these were started especially for growing seedlings for forest planting, but plainly must be inspected under the law. Some of the others make a specialty of ornamental stock with a view to supplying the local trade. The condition of the nurseries was on the whole rather better than last year, as many of the nurserymen now understand how to keep their stock free from scale and are giving this feature of the business much more attention than a few years ago. The list of firms receiving certificates in 1909 follows:

LIST OF NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1909.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Atwater, C. W.	Collinsville	Oct. 6,	334
Barnes Bros. Nursery Co.	Yalesville	Sept. 22,	329
Beattie, Wm. H.	New Haven	Oct. 20,	355
Bowditch, J. H.	Pomfret Center	Oct. 8,	339
Brainard, D. Wm. & C. F.	Thompsonville	Oct. 12,	344
Braley & Co., S. A.	Burnside	Nov. 1,	364
Burroughs, Thos. E.	Deep River	Oct. 18,	350
Burr & Co., C. R.	Manchester, Buckland, Durham,	Sept. 14,	328
Chapman, C. E.	North Stonington	Oct. 13,	347
Comstock & Lyon	Norwalk	Oct. 27,	360
Conine Nursery Co., The F. E.	Stratford	Oct. 7,	336
Conn. Agricultural College	Storrs	Dec. 7,	369
Conn. Agr. Experiment Station, Forest Nursery (S. N. Spring, State Forester, New Haven)	Rainbow (Windsor)	Oct. 13,	346
Conway, W. B.	New Haven	Oct. 20,	356
Dehn & Bertolf	Greenwich	Oct. 9,	342
Dwyer, John E.	Manchester	Sept. 24,	330
East Rock Park Nursery (G. X. Amrhyn, Supt.)	New Haven	Sept. 7,	325
Elm City Nursery Co,	New Haven	Sept. 11,	326
Fernwood Nursery	Stamford	Nov. 16,	367
Gardner's Nurseries	Cromwell	Oct. 27,	359
Gurney & Co., H. H.	New Canaan	Oct. 5,	332
Hale, J. H.	So. Glastonbury	Nov 23,	368
Holcomb, Irving	Granby	Oct. 2,	331
Houston & Sons, J. R.	Mansfield Depot	Nov. 15,	366
Hoyt's Sons Co., Stephen	New Canaan	Oct. 5,	333
Hubbard & Co., Paul M.	Bristol	Oct. 18,	351
Hunt & Co., W. W.	Hartford	Oct. 8,	338
Kelsey & Sons, David S.	West Hartford	Oct. 7,	337

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Keney Park Nursery (G. A. Parker, Supt.)	Hartford	Nov. 1,	365
Malone, Geo. W.	Highwood	Dec. 31,	371
Mitchell & Co.	Manchester	Oct. 22,	357
Mount Carmel Forest and Nursery Co.	Mt. Carmel	Oct. 11,	343
North-Eastern Forestry Co.	Hamden and East Haven	Oct. 8,	340
New Haven Nursery Co.	New Haven	Oct. 29,	363
Phelps, J. Wesson	Bolton	Oct. 29,	362
Pierson, A. N.	Cromwell	Sept. 14,	327
Platt Co., The Frank S.	New Haven	Oct. 27,	361
Purinton, C. O.	Hartford	Oct. 18,	352
Rosemore Nursery Co.	Litchfield (2)	Oct. 20,	354
Ryther, O. E.	Norwich	Oct. 25,	358
Schleichert, F. C.	Bridgeport	Oct. 15,	349
Schoonman, W. J.	Danielson	Dec. 17,	370
Scott, J. W.	Hartford	Oct. 12,	345
Sierman, C. H.	Hartford	Oct. 7,	335
Stannard, Mrs. E. P.	Westbrook	Oct. 13,	348
Vidbourne & Co., J.	Hartford	Oct. 9,	341
Woodruff, C. V.	Orange	Oct. 18,	353

INSPECTION OF IMPORTED NURSERY STOCK.

By W. E. Britton and B. H. Walden.

On January 10th, 1909, we received notice from Mr. George G. Atwood, Chief of the Division of Horticulture of the State Department of Agriculture, Albany, N. Y., that nests of the brown-tail moth, *Euproctis chrysorrhœa*, Linn., had been found on nursery stock brought into this country from France, and Mr. Atwood instructed us regarding the measures planned for handling such stock in New York City.

Though we are expecting each year to find the brown-tail moth in this State because of its natural spread from Massachusetts or Rhode Island, we cannot run the risk of its being brought into the State on nursery stock through lack of thorough inspection. An attempt was made, therefore, to inspect all importations so far as we could learn about them. On February 4th, Mr. Walden examined some stock at the nursery of C. R. Burr & Co., of Manchester, Conn., which had been grown by Louis Leroy, Angers, France. Some of the fruit

tree seedlings were found infested by nests of the brown-tail moth which were usually on the extreme tops of the shoots and were therefore rather conspicuous. The following notice was at once issued and sent to all nurserymen of the state:—

New Haven, February 5, 1909.

Dear Sir:—Several winter nests of the brown-tail moth *Euproctis chrysorrhoea* have just been found on nursery stock imported from France into Connecticut. The dangerously injurious nature of this pest is well known from its ravages in Massachusetts, New Hampshire and Maine, and, if possible, its further distribution and spread in this country must be prevented. I therefore request you to notify me at once of any importations received during the fall or winter and of any shipments expected this spring, so that inspection can be made. Please hold boxes until an inspector can reach your nursery before unpacking them. This is an important matter.

Very truly yours,

W. E. BRITTON,

State Entomologist.

The accompanying table shows the details of the examination of this imported stock.

In all 224 boxes and packages were examined, and the work necessitated 51 trips and the equivalent of 48 days' work for one man. Most of this inspecting was done by Mr. Walden, but Messrs. Hubbell and Britton also examined some of the stock. This work, though involving considerable time and expense which was needed for investigation, was deemed so important that it was not safe to neglect it.

Of all the stock inspected, only one lot, containing thirteen large boxes from the nursery of Louis Leroy, Angers, France, imported through the agency of H. Frank Darrow, 26 Barclay Street, New York City, was found infested. The boxes on arrival were all placed together in a barn, where they were kept for some time before being unpacked and before we knew of their arrival. Fifty-two winter nests of the brown-tail moth were found on fruit seedlings, a few on pear and quince, but most of them were on apple and dwarf apple stock. These nests contained living caterpillars. Some of the caterpillars leave their nests when in a warm place, and for this reason it was thought unsafe to allow the stock to go untreated. The nests were clipped off and destroyed, and all

seedling stocks dipped root and branch in a mixture of "Scalecide," one part in 20 parts of water. Moreover, the boxes, the interior of the storage house and the packing material, were all drenched with another kind of miscible oil, "Target Brand Scale Destroyer," used in the proportions of one part to about 12 parts of water. An attempt was made to burn the sphagnum packing material, but as it was wet, it was not a satisfactory treatment, and this material was then soaked with the oil preparation.

The dipped stock was pruned root and top, and some of it grafted and planted out. Though some of it failed to grow, the percentage was no greater than with some other lots of imported nursery stock not so treated.

In caterpillar time Mr. Walden made an inspection of the trees and other vegetation growing in the vicinity of the nursery and packing houses, and another examination was made in the fall, but no evidences of infestation by the brown-tail moth were found.

Some nests were found in Port Chester, N. Y., on nursery stock from Massachusetts, which was planted out on an estate only a few rods from the Connecticut line. The case was reported to us by Mr. C. T. Hotaling of Greenwich, and we at once communicated with the New York authorities. They investigated, found several caterpillars, and burned all vegetation over quite a large area. Subsequent inspections showed no traces of the preseuce of the insect in that locality.

The imported nursery stock was sent to nearly every state in the Union, and in some states thousands of brown-tail nests were found. It is extremely difficult for state inspectors to get track of importations except as notified by the nurserymen purchasing the stock. When asked for notice of the arrival of such stock, the customhouse officials have, in some cases, refused to give it, remarking that they were United States officials and were not obliged to take orders from state inspectors. Much of the stock, however, arrives at the port of New York, and New York state inspectors watched carefully and notified us and the inspectors of other states on the arrival of stock consigned to our respective states. In a few cases the Bureau of Entomology of the U. S. Department of Agriculture at Washington notified us of the

arrival of stock for Connecticut from foreign countries. Undoubtedly there were a number of importations entering through the port of New York of which we received no notice, as well as many shipments entering the state through other ports. This experience and the great danger of bringing serious pests into the country emphasize strongly the need of some adequate system of Government inspection, and it is hoped that some legislation along this line may be enacted by the present Congress. Most nations have systems of inspection of similar imports at the points of entry, but there has never been any provision for the Federal inspection of such stock in this country, and the only inspection that it receives is made by state officials. Some nations would have at once issued an embargo against all nursery stock entering the country from France, or even from Europe, after receiving infested shipments; but nothing of this kind was done by our Federal government.

Sources of Imported Nursery Stock.

Country.	No. of Boxes or Bales.
Belgium	2
England	16
France	71*
Germany	93†
Holland	109
Japan	6
Unknown	9
Total	306

PROVISION FOR THE INSPECTION OF APIARIES TO SUPPRESS CONTAGIOUS DISEASES OF BEES.

A bill providing for the inspection of apiaries in Connecticut was introduced into the legislature of 1907 by the Connecticut Beekeepers' Association. Owing to the form of this bill and to the fact that the members were not united in their opinions regarding the requirements of such a law, the matter was reported unfavorably by the committee. The members of the association agitated the question, and it was suggested that the

* One shipment contained 52 nests of brown-tail moth.

† All small pine seedlings for forest planting. Only a small portion examined.

work be placed in charge of the station; a bill to that effect was therefore drawn up and introduced into the legislature of 1909. After the usual number of hearings and changes in the bill made by the committee, the following bill was passed:

AN ACT CONCERNING THE SUPPRESSION OF CONTAGIOUS DISEASES AMONG BEES.

Chapter 185 Public Acts of 1909.

SECTION 1. *Duty of state entomologist to act on complaint.* For the purpose of suppressing contagious or infectious diseases of the honey bee, it shall be the duty of the state entomologist, when complaint is duly made, to examine and verify, and treat or destroy cases of foul brood among honey bees.

SEC. 2. *Authority to appoint inspectors and to examine apiaries.* In pursuance of the provisions of this act, the state entomologist or any person whom he may appoint for that purpose shall have access at reasonable times to such apiaries or places where bees are kept and where honeycomb and appliances are stored as may be designated in any such complaint.

SEC. 3. *Authority to make regulations.* The state entomologist is authorized and empowered to prescribe suitable forms for and make regulations regarding such complaints, and shall keep the same on file and open to public inspection; and he is further authorized and empowered to make, in his discretion, reasonable rules to govern, and reasonable payments for the services of agents whom he may appoint to carry out the provisions of this act.

SEC. 4. *Obstruction illegal. Penalty.* Any person who impedes, resists or hinders the state entomologist or any agent whom he may appoint in the performance of the duties imposed by this act shall be fined not more than twenty-five dollars.

SEC. 5. *Provision for defraying expenses.* To carry out the provisions of this act the necessary expenses, to an amount not exceeding five hundred dollars, shall be paid by the comptroller on duly accredited vouchers.

Approved August 2, 1909.

This law did not go into effect until October 1st, 1909, too late to do any work this season. On October 20th the following inspectors were appointed:

H. W. Coley, Westport—Inspector for Fairfield, New Haven, Middlesex, and New London counties.

A. W. Yates, Hartford—Inspector for Litchfield, Hartford, Tolland and Windham counties.

The appropriation for the work is very small, being only $500 for two years. It will be impossible to cover the entire State on this amount of money, but a start can be made. As inspections can be made only on complaint, it is necessary to have complaint blanks filled out and signed. These can be sent to the office of the state entomologist or to the inspector named above under whose jurisdiction the locality may be.

Blanks for these complaints have been printed and two of them with a circular letter have been sent to each member of the Connecticut Beekeepers' Association. The form of the blank and a copy of the letter are given below:

APPLICATION FOR APIARY INSPECTION.

——————19

W. E. BRITTON, State Entomologist,
Agr. Expt. Station, New Haven, Conn.

Dear Sir:

The apiary of Mr. —————— of ——————, Conn., is suspected of being infested with either American or European foul brood, and I therefore respectfully request that you have it examined under the authority given you by the Public Acts of 1909, Chapter 185.

Yours truly,

——————

Address——————

Complainant.

OFFICE OF STATE ENTOMOLOGIST.

AGRICULTURAL EXPERIMENT STATION.

NEW HAVEN, CONN.

February 15, 1910.

TO THE BEEKEEPERS OF CONNECTICUT:

Dear Sir:

I am mailing you in this letter some blank applications for apiary inspection. After being filled out, they can be sent either to me or to the inspector of your district named below:

H. W. COLEY, Westport, Conn., inspector for Fairfield, New Haven, Middlesex and New London counties.
A. W. YATES, Hartford, Conn., inspector for Litchfield, Hartford, Tolland and Windham counties.

Each blank must be filled out in detail, if possible giving definite directions about the location of the apiary. It must also be signed. A man may sign an application for the inspection of his own apiary.

Please send to this office the names of all beekeepers in your locality, together with any other information, such as number of colonies in each apiary, for permanent filing to aid us in this work.

Very truly yours,

W. E. BRITTON,

State Entomologist.

Card records of the apiaries of the State (as far as the information can be secured) and all inspections of them will be kept on file in the office of the state entomologist and open to the public during office hours.

Beekeepers and others interested can aid by sending information regarding their apiaries or the names of other beekeepers.

MUNICIPAL SPRAYING OF ELM TREES IN CONNECTICUT IN 1909.

Serious injury to elm trees by the elm leaf beetle for the two seasons of 1907 and 1908 led us to expect in Connecticut an attack of extraordinary severity in 1909. The danger was further indicated by the drought of July and August, when usually many of the pupæ are killed by the white mold fungus which is prevalent in a moist season, and later by the unusually large number of adults which appeared in the spring.

Warning was therefore given in the last report and in the various lectures given by the state entomologist. Several towns and cities through their selectmen, directors of public works, park superintendents, and tree wardens, conferred with the state entomologist, who gave advice and in a number of cases visited the locality and examined the trees. There was quite a demand for illustrated lectures on the "Care and Protection of Shade Trees," and the state entomologist gave thirteen such lectures on this subject before granges, schools, village improvement and civic associations. At a town meeting in Clinton, May 19th, it was voted to appropriate $1,000 for spraying the elm trees, there being about 800 trees of this kind along the street and highways of the town. Several other towns raised money by taxation to care for their shade trees. In some cases the town authorities purchased spraying apparatus and hired local help to do the work, while in other towns the spraying was done by contracting firms who make a specialty of such work. Where

town or city funds could not be obtained for the purpose, improvement associations raised money and hired the work done, or provided for having it done at the owner's expense where authorized to do so.

The city of New Haven let a contract to spray 7,500 elm trees in the original twelve wards, giving two sprayings at the rate of about $1.49 per tree.

The statistics collected by this office show that over 20,000 elm street trees in the State were sprayed in 1909 and at least nearly half of these were sprayed twice. No doubt there were many others of which we received no record. In addition there were also hundreds of elm trees on private grounds that were sprayed to forestall the attacks of the beetle.

The following is a list of persons and firms known to have done commercial spraying in Connecticut in 1909 and is given here merely for the convenience of those who desire to communicate with such persons and firms for estimates and bids. It should be understood that in publishing this list the station in no way endorses or guarantees the work done by these firms. Much of it, however, is known to us and must be considered satisfactory.

List of Firms Engaged in Commercial Tree Spraying in Connecticut in 1909.

Allen, Geo. G.	New Haven, Conn.
Arnold, A. S.	Danbury, Conn.
Cornell, Joseph	Norwalk, Conn.
Dehn & Bertolf	Greenwich, Conn.
Frost & Bartlett Co., H. L.	Stamford, Conn.
Hazard, James O.	Westerly, R. I.
Hotaling, Chas. T.	Greenwich, Conn.
Kimball, F. L.	Norwich, Conn.
Lindeman, C. T.	R. F. D. 2, Putnam, Conn.
Mount Carmel Forest and Nursery Co.	Mount Carmel, Conn.
Munson & Whittaker Co.	Boston, Mass., and New York, N. Y.
New Haven Forestry Co.	966 Grand Ave., New Haven, Conn.
Providence Forestry Co.	840 Chapel St., New Haven, Conn.
Purinton, C. O.	Hartford, Conn.
Shattuck & Co., Frederick B.	Tremont Bldg., Boston, Mass.
Schoonman, W. J.	Danielson, Conn.
Schults & Co., W. F.	Hartford, Conn.
Sierman, Chas. H.	Hartford, Conn.
Smith, M. H.	Natick, Mass.

Stevens, Jr., F. V. ....Stamford, Conn.
Taylor, James ....Wallingford, Conn.
Withers, J. T. ....1 Montgomery St., Jersey City, N. J.
Woundy, B. S. ....New Canaan, Conn.

COMBATING THE GYPSY MOTH IN CONNECTICUT.

Stonington Infestation.

For previous accounts of the discovery of this pest and efforts to exterminate it at Stonington, the reader should consult the reports of this station (1905, p. 246; 1906, p. 235; 1907-08, pp. 300 and 772).

The scouting was done in the winter of 1908-09 by Mr. G. H. Hollister, who has had immediate charge of the work as local superintendent for three years, and Mr. Miller, a scout furnished by Mr. D. M. Rogers, special field agent in charge of the gypsy moth work for the Bureau of Entomology.

Only six egg-clusters were found.

Early in February, 1909, Mr. Hollister began work for H. L. Frost & Bartlett Co., pruning and spraying trees, and returned to the gypsy moth work at Stonington about July 1st. He was also able to help there for about a week early in May, while the trees were being banded with burlap. During the remainder of the time through May and June Mr. Fred Hoadley was in charge of the force.

As the result of our efforts during the three preceding years the infested area had been reduced so it was not considered necessary to band as many trees as heretofore. About 6,000 trees were banded and though a careful search was made only ninety-eight caterpillars were found. Considerable scouting was done during the caterpillar season, especially around the outside edges of the infested area. No caterpillars were found this season at Walnut Grove, though the trees were banded as usual and were faithfully watched.

Messrs. Dennis and Casey, government scouts, were sent to Stonington by Mr. Rogers, and in company with Mr. Hollister, they scouted the infested territory again during the second week in December. Only one egg-mass was found. The government scouts afterward examined the territory northeast of Stonington toward Westerly, R. I., but nothing was found.

The following figures show the results of our work at Stonington:

Date.	Egg-masses destroyed.	Caterpillars destroyed.	Cocoons destroyed.
1906	73	10,000	47
1907	188	2,936	200
1908	76	2,560	44
1909	6	98	0

It seems therefore that the gypsy moth is well under control at Stonington. Probably a few caterpillars will be found there the coming summer, and it will be necessary to repeat the work of banding the trees for at least two more seasons, and even after it is thought to be exterminated, the locality will require careful examinations annually for several years.

Mr. Hollister scouted for about two weeks in the northeastern part of the State and furnished the following notes:

"The following towns and villages were visited and sections looked over in search for any evidences of the gypsy and brown-tail moths: Putnam, Danielson, Plainfield, Dayville, Moosup, Sterling, East Killingly, Thompson and East Thompson.

The trees and bushes, and in some cases fences and buildings in the vicinity of the railroad stations, were looked over and also those near the garages.

The trees and bushes along the trolley road from Danielson to East Killingly were also scouted and those along the highway leading from Putnam north to the state line.

This scouting was done during the latter part of January, 1909. No evidence of either species of moths were found in the above-mentioned places."

Wallingford Infestation.

Discovery of the Gypsy Moth at Wallingford. The following clipping was taken from the Wallingford news in one of the New Haven daily papers of Monday evening, December 13th, 1909:

"Warden Becroft yesterday discovered cocoons containing eggs of what he is informed are gypsy moths. They are on maple trees on North and South Colony Streets, Meadow Street and North Whittlesey Avenue. The street department will get busy to-day with a wash of creosote, and it is requested by the warden

that residents throughout the borough investigate and ascertain, if possible, if cocoons of a similar nature are to be found elsewhere. The warden claims the moths were brought here by autos passing along Colony Street."

This item was noticed by Mr. Walden, who brought it to the office the next morning and who was sent to Wallingford during the day to investigate the report. Before he could find Warden Becroft to learn the source of the report or the locality infested, Mr. Walden noticed two egg-masses on the trunks of trees on Whittlesey Avenue, and at once telephoned the news to the office, and the entomologist visited the place in the afternoon. By this time Mr. Walden had found a spot on Union Street where egg-clusters were abundant and counted nearly 300 on one tree. A large number were found on some of the maple trees along this street and on several backyard apple trees.

The presence of this pest in Wallingford was discovered by Mr. Leslie A. Brown, a designer of silverware in the factory of the R. Wallace & Sons Mfg. Co. Mr. Brown lives at 179 Christian Street, near the corner of Main, and in traveling to his work takes a diagonal route toward the factory, crossing Whittlesey Avenue, Orchard and William streets, through Meadow to Church and Colony and thence down Quinnipiac Street to the factory. It was on Meadow Street near Church where Mr. Brown noticed a cluster of eggs on the trunks of a maple tree one morning on his way to work. The next morning he saw several other egg-clusters in the vicinity and informed Mr. William E. Becroft, the warden of the borough.

Mr. Brown formerly lived in Newburyport, Mass., and moved to Wallingford in October, 1908. He had seen the gypsy moth at his old home in Waltham, Mass., and was thus able to recognize the egg-clusters when he saw them in Wallingford, though he had passed the trees a great many times without noticing them.

Mr. Becroft then looked about and saw a few egg-clusters on each of the several streets in that vicinity and noticed some not far from his own house on North Whittlesey Avenue. The worst infested spots, however, had escaped notice until discovered by Mr. Walden.

Destroying Egg-Masses. The next day (December 15th) we had men at work soaking these egg-clusters with creosote oil

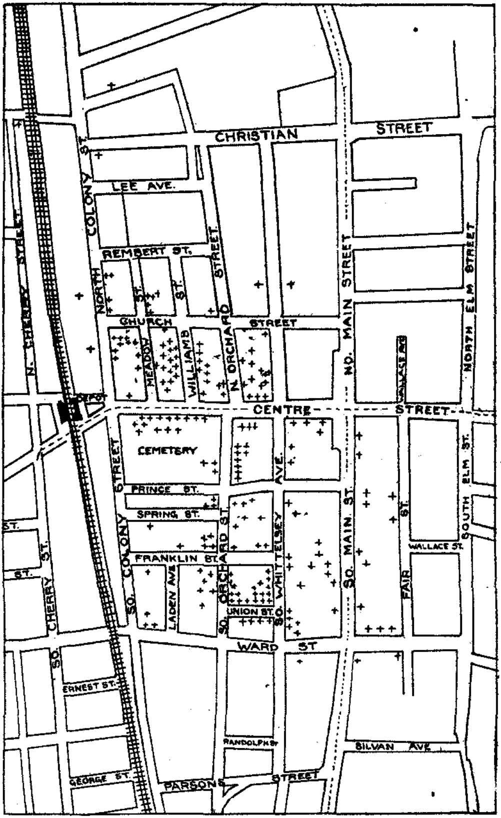


Fig. 1. Map of Wallingford, showing the region infested by the Gypsy Moth. The check marks show where egg-clusters were found during the winter of 1909–10.

to prevent their hatching if broken open and the eggs scattered. Warden Becroft furnished one man, who was used to climbing, and who worked the remainder of the week with Mr. Graham and Mr. Walden, the latter being in charge.

The following week Mr. Hollister, who had been scouting in Stonington, worked for five days at Wallingford in scouting and destroying egg-masses. Back of the stores on Center Street, between Meadow and William streets, was a bad center of infestation which now appears to have been the original one, from which the pest may have been carried to the vicinity of Union Street on rubbish placed on the Whittlesey Avenue dump. A heavy snowstorm on Christmas day preventing further scouting work, but up to this time nearly 6,000 egg-clusters had been found and destroyed.

Educational Work in Wallingford. Some of the gypsy moth cards issued three years ago were distributed by Warden Becroft in store windows and other conspicuous places around Wallingford. On February 7th, seventy-five of these cards were sent by request to Mr. Marsh, superintendent of schools, who agreed to place one in each schoolroom in town.

Life history sets of the gypsy moth in Riker mounts, 6½ x 8½ inches in size, were prepared and five (one for each building) furnished to the schools. One was placed on exhibition in the public library.

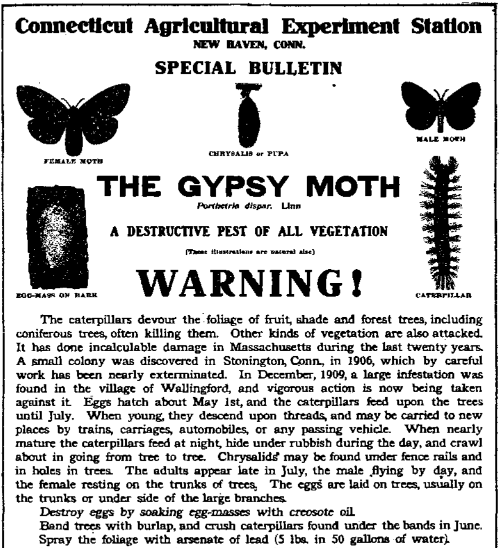
On December 23d, the state entomologist, Dr. Britton, gave an illustrated lecture on the gypsy moth before the Wallingford Grange, showing a number of local views. Dr. Jenkins was also present, and spoke briefly regarding local conditions. The meeting was an open one, to which the public had been invited. Nearly one hundred persons were present, some of whom were not members of the Grange.

On January 3d, Dr. Jenkins lectured before the Ladies' Aid Society in the public library and referred to the gypsy moth infestation in Wallingford and to the local conditions.

On February 1st, Dr. Britton lectured to the teachers and pupils of the Wallingford public schools, showing lantern slides.

Warning Notices Scattered Over the State. The coöperation of the New York, New Haven & Hartford Railroad Company was sought and permission received to post warning notices in the waiting-rooms of the railroad stations throughout the State.

A new and revised edition was printed of the cards issued three years ago and a copy was sent January 13th to each station agent of the road in Connecticut. The railroad company kindly



Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

SPECIAL BULLETIN

FEMALE MOTH

CHRYSALIS or PUPA

MALE MOTH

THE GYPSY MOTH

Porthetria dispar, Linn

A DESTRUCTIVE PEST OF ALL VEGETATION

(These illustrations are natural size)

EGG-MASS ON BARK

WARNING!

CATERPILLAR

The caterpillars devour the foliage of fruit, shade and forest trees, including coniferous trees, often killing them. Other kinds of vegetation are also attacked. It has done incalculable damage in Massachusetts during the last twenty years. A small colony was discovered in Stonington, Conn., in 1906, which by careful work has been nearly exterminated. In December, 1909, a large infestation was found in the village of Wallingford, and vigorous action is now being taken against it. Eggs hatch about May 1st, and the caterpillars feed upon the trees until July. When young, they descend upon threads, and may be carried to new places by trains, carriages, automobiles, or any passing vehicle. When nearly mature the caterpillars feed at night, hide under rubbish during the day, and crawl about in going from tree to tree. Chrysalids may be found under fence rails and in holes in trees. The adults appear late in July, the male flying by day, and the female resting on the trunks of trees. The eggs are laid on trees, usually on the trunks or under side of the large branches.

Destroy eggs by soaking egg-masses with creosote oil.

Band trees with burlap, and crush caterpillars found under the bands in June.

Spray the foliage with arsenate of lead (5 lbs. in 50 gallons of water).

It is a violation of the law to transport living specimens.

Persons finding insects or egg-masses resembling the gypsy moth are asked to kill the specimens by dropping them into alcohol or gasoline, and send them for identification to

W. E. BRITTON, State Entomologist

Agricultural Experiment Station New Haven, Conn.

Fig. 2. Facsimile of warning notice posted throughout the State.

furnished a list of the addresses of the station agents, and also issued orders to them that the cards be posted in the stations. Similar arrangements were made by the Central Vermont Railroad Company, and cards have now been posted in all railroad

stations in Connecticut. Cards were also mailed to all postmasters in the State, with a request that each card be put in a conspicuous place, and to the secretaries of all granges in the State.

How Did the Pest Reach Wallingford? This question cannot be answered, because we have no direct knowledge and can only give what seems to be the most plausible explanation of it. As the area back of the stores on Center Street, between Meadow and William streets, was by far the worst infested section, it was probably the starting point of the infestation. As these stores are constantly receiving goods from manufacturers and dealers in the infested region of Massachusetts, it is not improbable that an egg-cluster was brought on a crate or packing box and left in the rear of one of the stores. Possibly some family may have moved from eastern Massachusetts into one of the houses nearby, bringing unwittingly and unnoticed an egg-mass upon the packing cases or garden utensils.

The Whittlesey Avenue and Union Street infestations are quite near the spot where rubbish is dumped on South Whittlesey Avenue and may be explained, we think, by its presence.

From the size and appearance of the Wallingford infestation and the abundance of the egg-clusters, it is probable that the gypsy moth has been there at least four years, but how it could have escaped detection for so long when so abundant is hard to understand.

Up to March 1st, about 7,500 egg-clusters had been found and destroyed.

Organization and Progress of the Suppression Work. Mr. Donald J. Caffrey, a graduate of the Massachusetts Agricultural College, has been secured as local superintendent in charge of the work. Mr. Caffrey began his duties in Wallingford January 24th, 1910, and at this writing has four men under him. With what local help and coöperation he can obtain from the property owners and borough officials, the trees in the infested section will be pruned, scraped and the cavities filled or tinned over, and some of the fences, outhouses and chicken coops overhauled before the eggs hatch May 1st. In order to do effective work it will be necessary to spray most or all of the trees, shrubs and hedges in this section after the leaves appear. For this purpose a mixture of lead arsenate will be used. The spruce

hedge around the cemetery is infested and will need to be thoroughly treated with lead arsenate and tree tanglefoot. All trees within this infested area will be banded with burlap next season, and in order to care for the work in a proper and effective manner, men must be kept at work until the middle of August or first of September.

The illustrations accompanying this report, Plates II-XI, show much better than any verbal description, the conditions of the infested region.

Mr. Dexter M. Rogers, special field agent of the Bureau of Entomology, in charge of gypsy moth work, with headquarters at Boston, was informed of this newly-discovered infestation, and visited it on December 20th, in company with Drs. Jenkins and Britton. Mr. Rogers expressed a willingness to coöperate in the suppression work, and we requested him to send scouts to help us examine the region around the village. On February 9th he brought three men, who are now at work.

It is too early to make any definite statements regarding the limits of the infestation, but no egg-clusters have been found outside of the village and nearly all of those destroyed were found between the railroad and Main Street and between Ward Street on the south and Christian Street on the north. Several egg-clusters were found east of Main Street near Ward.

Every effort will be made to exterminate the Wallingford gypsy moth colony. This is the farthest west of any existing infestation and if it is not suppressed will be a constant menace not only to the whole State of Connecticut but to New York and New Jersey as well.

THE ROSY APPLE APHIS.

Aphis sorbi Kalt.
Aphis pyri Boyer.
Aphis malifoliæ Fitch.

Though the season of 1909 was especially an aphid year and nearly all kinds of plant lice were abundant, the kind that probably caused more damage than any other is a pinkish or purplish species found on the fruit spurs of apple trees and called the rosy apple aphis. This species has of course been present in Connecticut for a long time, though there are few

records. I have observed it in a number of different localities during the past sixteen years; but apparently it did little damage and scant attention was paid to it. In 1908, however, it was brought to my attention in the orchard of Mr. E. M. Ives of Meriden, and it was chiefly there that these studies were made, some of the work being done by Mr. Arthur I. Bourne between June 24th, when he entered the employ of this office, and November 18th.

During 1909 it was much more serious than in the preceding year and caused great damage to apples—not only to the season's crop of fruit but to the trees as well.

Specimens were received from Putnam, Manchester, Wallingford, West Haven and Stratford, and the insect was observed at several other places.

Difference Between the Green and Rosy Apple Aphids.

The most troublesome plant lice on apple in Connecticut are the green apple aphis, *A. pomi* De Geer, and the rosy apple aphis, the identity of which seems not to have been well established. For instance, we find accounts of apparently the same insect as *Aphis sorbi* Kalt., as *Aphis pyri* Boyer., and as *Aphis malifoliæ* Fitch. The green apple aphis was described briefly and figured in the report of this station for 1903, page 259. It attacks the terminal shoots and tender leaves, causing the leaves to curl. It affects the tree chiefly by restricting the growth and is much more serious on young orchard trees and nursery stock than upon old trees. All stages are bright green except the oval egg, which is green when first laid but soon turns to a shining black. Eggs are laid on the terminal twigs late in the season and are conspicuous and often abundant. The rosy apple aphis is pink or purplish in color and seems especially prone to attack the fruit spurs and the inner portions of the tree top rather than the terminal twigs and exterior part. The eggs are smaller and much less conspicuous than those of the green apple aphis, and one often needs to hunt carefully in order to find them at all, as they are hidden around the buds, sometimes partly under the scales.

The attacks of the rosy apple aphis affects seriously the fruit and prevents its growth and development, causes it to be gnarled

and irregular in shape. The leaves curl early and often turn yellow and fall late in June if badly infested.

The green apple aphis remains on the apple leaves and shoots throughout the season, but the rosy apple aphis leaves the apple and goes to some other unknown plant host—during the latter part of June—returning to the apple in October and later laying eggs to carry the species through the winter.

Life History.

The eggs of the rosy apple aphis hatch about the middle of April just as the green leaves begin to show at the ends of the buds. On April 16th, in Mr. Ives's orchard at Meriden, the aphids were hatching and the buds had opened just enough to show the green tissue. Many newly-hatched aphids could be seen on the opening buds, though many eggs were still unhatched.

These aphids were abundant through blossoming time and were thick on the young fruit. During the latter part of June, or about the first of July, they disappeared entirely from the trees and did not return again until October.

On November 12th, 1909, the aphids were laying eggs, though but a few could be found.

Description.

The following description and measurements were made by Mr. Bourne:

1st Stage. Color is an almost transparent white when just born, rapidly changing to a cream white as they begin to feed. Eyes are very conspicuous—deep red. Body nearly oval. Posterior end of abdomen bluntly pointed. Antennæ almost equaling length of body, 5-jointed; 3d and 5th joints much the longest. Joints 1 and 2 hardly longer than wide. Antennæ remote at base, no frontal tubercles. Head, broad, flat in front between bases of antennæ. No noticeable lines of division into the three body regions. Legs, long in proportion to size of body. Tarsi and joints of tibiæ, dusky. Beak, long, slender, reaching beyond the 3d coxæ. Cornicles, short, scarcely more than tubercles, not longer than 1st segment of abdomen. Wider at base than tips. Cut off square at ends. Straight. No cauda noticeable in this stage.

2d Stage. Almost twice as large as 1st stage. Color, a deeper yellow. Eyes very deep red. Much more developed than in preceding stage. Body, very convex, almost oval. Head, flat in front. No constriction back of eyes. A very short tubercle, hardly more than a ridge, on each margin of prothorax just back of eyes. Antennæ, 6-jointed. Outer joint the longest and dusky. Do not reach quite to base of cornicles. Tarsi and joints of tibiæ and last joint of beak, dusky. Cornicles equal in length two segments of abdomen. Straight, somewhat tapering and tips flaring a little and quite dark. Legs are not so large in proportion to size of body as in 1st stage. Tibiæ are distinctly hairy, especially toward tip.

3d Stage. (Form that will be wingless.)

Color, brick red. More noticeable along dorsal portion of head, thorax and margin of abdomen. Body, much more convex and considerably larger than preceding stage. Tips of antennæ, joints of tibiæ, whole of tarsi, tips of cornicles and of rostrum, a dusky color. Antennæ, 7-jointed, reaching back beyond the base of cornicles; 3d and 7th joints nearly the same length. Head, narrowed slightly in front, back of eyes broadens considerably. Eyes dark red, almost black, with a prominent ocular tubercle and prominent tubercles on prothorax. Each segment of abdomen with a tubercle on margins. Cornicles, of medium length, straight, tapering slightly, quite slender, ends flaring. Dorsal portion of abdomen, a faint greenish yellow. Can begin to distinguish the embryos forming within. Legs of medium length, with distal ends of tibiæ covered with long bristly hairs, as is the very tip of abdomen. Beak, quite long and slender, reaching a little beyond 3d coxæ.

3d Stage. (Winged form.)

Body, some longer and of about same width as other form. The color is paler somewhat than in wingless form. More of a yellowish tinge, especially near dorsal portion of abdomen. Tips of antennæ, cornicles, tibiæ and beak and whole of tarsi, dusky. Eyes, dark red, as in other form. Antennæ, 7-jointed, not quite reaching base of cornicles. Legs, only moderately long. Cornicles, rather short and thick. Slightly tapering. Ends cut off square on 2d segment of abdomen in front of cauda. Two short blunt tubercles, and on the last two segments of thorax are a pair of wing pads, giving the appearance of shoulders to the insect. Ocular tubercle very prominent. Short blunt tubercle

on each segment of abdomen on margins. Beak, slender, reaching to posterior coxæ.

4th Stage. (Winged.) Brick red, most pronounced on head and thorax. End of abdomen, wing cases, antennæ, legs and beak, yellowish. Tips of antennæ and beak, cornicles and tarsi, dusky. Body is somewhat covered with a powdery substance. Is more elongated than oval. Cornicles, straight, wider at base than tips. Tips flaring. Not reaching to the end of the abdomen. Cauda, none or inconspicuous. Abdomen, tipped with a few long hairs. Antennæ, reaching but little beyond middle of abdomen. Eyes, very dark red. Ocular tubercles present, not as prominent as in wingless form. Head constricted somewhat just behind the eyes. Prothorax with two prominent lateral tubercles. Two pairs of wing cases very prominent. Front pair much longer than hind pair. On abdomen, the two segments from end each bear a pair of tubercles. The outer pair small, set nearer together. Tips, dark. Short. A tubercle on each segment of abdomen on outer margin. Embryos can be plainly seen through the dorsal portion of abdomen. Beak, slender, reaches almost to posterior coxæ.

4th Stage. (Wingless.)

Color, same as in winged form. Brick red on head, thorax and margin of abdomen. On dorsal portion of abdomen color is changed from red to orange and yellow, and the embryos can be seen within. Antennæ, tibiæ, cornicles and beak with thin tips, dusky. Cauda, inconspicuous. Two pairs of tubercles on segment before tip of abdomen, as in other forms of the same stage. Each segment of abdomen with a short tubercle on each margin. Abdomen, very convex, almost as broad as long. Prothorax, with two prominent tubercles. Tibiæ, distinctly hairy. Head, narrower in front than back of antennæ. Eyes, very dark red. Ocular tubercle, prominent. Beak, only moderately long, not reaching much beyond 2d coxæ. Antennæ, almost reaching to bases of cornicles, 7th joint longest. Considerably smaller than adult and not nearly so convex even in proportion to length. Body, sometimes covered over with powdery substance.

Adult. (Wingless.)

Color, head, thorax and margin of abdomen dark reddish brown. Quite dark and usually covered with a powdery substance which gives the insect a deep blue color. Along the top

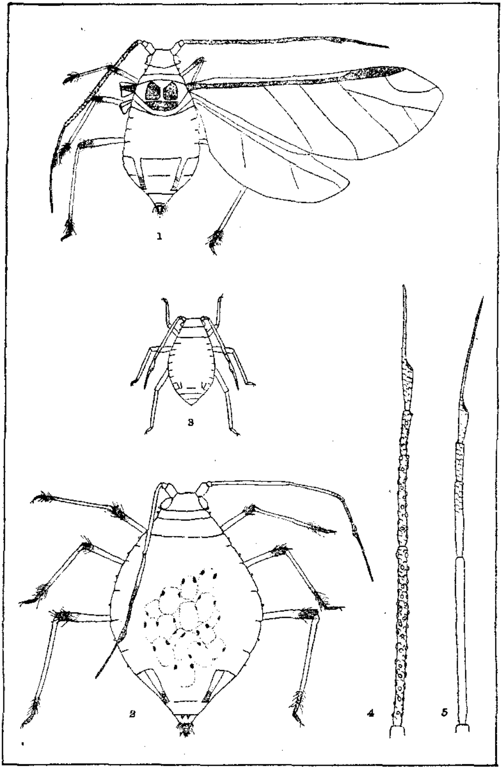


Fig. 3. Rosy Apple Aphis. 1, winged viviparous female; 2, apterous viviparous female; 3, young nymph; 4, antenna of winged viviparous female; 5, antenna of apterous viviparous female. All greatly enlarged.

of abdomen the color fades to a lighter yellow and the embryos within give a greenish tinge to the abdomen. Legs, white, except tips of tarsi and tibiæ, which are dusky. Beak tipped with black. Cornicles, pale greenish yellow tipped with black. Antennæ, almost transparent, except tips, which are dusky. Eyes, reddish black. Head, narrow in proportion to rest of body. Antennæ set wide apart and fixed directly to the head. A short tubercle midway between bases of antennæ in front. Ocelli present. Ocular tubercles, not very conspicuous. Antennæ, 7-jointed. 3d longer than other joints. Reaches a little over half the length of the abdomen to bases of cornicles. Beak, slender, reaching halfway between middle and posterior coxæ. Prothorax, with two prominent tubercles. On other segments there are a pair of blunt tubercles, hardly more than ridges, the 2d pair being the more prominent. Legs, long and to some extent hairy. Abdomen, with short blunt tubercles on outer margins of each segment. Along the dorsal portion the eyes of the embryos within are very conspicuous. Cornicles, moderately long, tapering slightly. Ends flaring, do not reach quite to end of body. Cauda, small, not very conspicuous. Hairy. On the two segments in front of cauda are two pairs of small tubercles, the pair next to cauda being the smaller and closer together.

Adult. (Winged.)

Head, dull black. Eyes, black. Ocular tubercles prominent. Antennæ dusky, except very tips, which are almost transparent. Seven joints; 1st and 2d short and thick; 3d and 4th very thickly set with sensoria. No frontal tubercles. Reach almost the length of body. Beak, rather short, not quite reaching middle coxæ. Thorax, 1st segment, yellowish red with prominent lateral tubercles. Meso and meta thorax, dusky, almost black. Bases of wings a somewhat lighter shade. Legs, distinctly hairy, moderately long. Outer tips of femora, tibiæ and whole of tarsi, dusky. Abdomen, yellowish, almost orange. Lighter along dorsal portion than on margins. Embryos plainly seen. Give a faint greenish tinge to the dorsal portion of abdomen. The margins of each segment with a short blunt tubercle. Cauda, short, not prominent. Tipped with black. Two pairs of tubercles on two segments just in front of cauda, the posterior tubercles being smaller and nearer together. Cornicles, moderately long, tapering somewhat, with their ends flaring. Wings

Table I.—Rosy Apple Aphis. Measurements.

Stage.	Body.		Corni-cles.	Antennæ.						Tibiæ.		
	Length.	Breadth.		Total.	3d joint.	4th joint.	5th joint.	6th joint.	7th joint.	1st joint.	2d joint.	3d joint.
1st	.968 mm	.54 mm	.09 mm	.66 mm	.23 mm	.07 mm	.25 mm	....	....	.268 mm	.306 mm	.36 mm
2d	1.36 "	.738 "	.144 "	.81 "	.23 "	.108 "	.07 "	.27 mm	....	.324 "	.342 "	.432 "
3d (wingless)	1.7 "	1.00 "	.216 "	1.38 "	.324 "	.234 "	.18 "	.108 "	.378 mm	.358 "	.376 "	.756 "
3d (winged)	1.72 "	1.02 "	.216 "	1.17 "	.216 "	.196 "	.104 "	.09 "	.378 "	.432 "	.45 "	.63 "
4th (wingless)	2.07 "	1.18 "	.288 "	1.4 "	.396 "	.27 "	.162 "	.108 "	.432 "	.612 "	.648 "	.811 "
4th (winged)	2.28 "	1.2 "	.36 "	1.5 "	.396 "	.288 "	.180 "	.108 "	.45 "	.63 "	.684 "	.9 "
Adult (wingless)	2.73 "	1.45 "	.36 "	1.78 "	.486 "	.342 "	.198 "	.108 "	.474 "	.738 "	.774 "	1.008 "
Adult (winged)	2.5 "	1.08 "	.33 "	2.37 "	.702 "	.45 "	.27 "	.108 "	.630 "	1.06 "	.974 "	1.27 "

Adult (winged)—Wing expanse 5.4 mm.

with 3d discoidal vein having first branch arising at point about half its length; 2d branch nearer apex of wing than base of vein. Stigma quite long, narrow, and pointed sharply at outer end.

Parasites of Rosy Apple Aphis.

The rosy apple aphis was highly parasitized in Connecticut in 1909. The illustration on Plate XIII, b, shows the appearance of the parasitized individuals on a single leaf. They were very much swollen and brown in color. The most important parasite of the rosy apple aphis in Connecticut in 1909 proved to be *Megorismus fletcheri* Cwfd.

Sanderson bred *Lysiphlebus cucurbitaphidis* Ashm. and *L. myzi* Ashm. from parasitized individuals of this aphis in Delaware* and mentions the predaceous insects *Chilocorus bivulnerus* Muls., *Prionidus cristatus* Linn and *Leucospis nigricornis* Egger as feeding upon it.

Other Host Plant Still Unknown.

Mr. Bourne spent considerable time searching the wild and cultivated plants of the fields and roadsides during the summer to ascertain the other host-plant of the rosy apple aphis, which had almost entirely disappeared from the apple trees by the middle of July. Several times Mr. Bourne examined all common shrubs, weeds and grasses growing in the vicinity of the orchard, particularly in the direction of the prevailing winds, but could not obtain even a trace of the intermediate host-plant of the aphid.

Remedial Treatment.

On April 16th, three apple trees at Mr. Ives's were sprayed with Rex lime and sulphur wash, two with a dilution of one part to nine parts of water and the other at the rate of one to twelve. At the time of this treatment the eggs were hatching and many young aphids could be seen on the opening buds. There were, however, plenty of unhatched eggs.

Nearby trees which Mr. Ives had sprayed with a mixture sold as Cooper's V_1, one part to 100 parts of water, showed hatched aphids.

The practical value of these tests was not demonstrated, probably on account of the few trees treated and the nearness of

* 12th Rept. Del. Agr. Expt. Sta., 1900, p. 190.

the untreated trees. Even if the eggs had all been killed, which was hardly possible, reinfection from adjacent trees would be extremely easy.

Gilette states* that lime and sulphur mixtures are among the substances most effective in destroying eggs of the green apple aphis in Colorado, and Hodgkiss reached similar results with his tests on eggs of various species of aphids in New York.†

Tests were made with kerosene emulsion in different dilutions late in June to determine the proper strength to use. The emulsion standard was prepared after the formula printed on the spray calendar and is as follows:

Kerosene Emulsion.
2 gals. kerosene.
½ lb. common soap.
1 gal. water.

Dissolve the soap in hot water, add the kerosene, and churn together until a white creamy mass is formed which thickens on cooling.

Used this emulsion June 29th at the rate of one part to six parts of water and of one part to nine parts of water. Into the diluted emulsion were dipped typical infested branches. Fourteen trees scattered throughout the orchard were included in this test and both trees and their dipped branches were marked.

The dilute emulsion killed the aphids quickly when brought in direct contact with them. This could be done by dipping the branches, but would not be accomplished so successfully by spraying on account of the curled leaves.

As the winter eggs are so scarce and as the aphids multiply with such rapidity during May and June, it is a question whether any treatment aimed at the destruction of the eggs will prove wholly successful in an aphid season. We expect to make further tests in 1910 to determine this point.

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* Bull. 133, Col. Agr. Expt. Station, p. 27, 1908.
† Bur. Ent. Bull. 67, p. 29, 1907.

THE BUD MOTH.

Tmetocera ocellana Schiff.

For two or three seasons apple trees in certain portions of Connecticut have been seriously injured by a small lepidopterous larva that feeds upon the opening leaves, often curling them and fastening them together. In Stonington, especially, this injury was important and of a serious nature. It was observed in New Haven, Meriden, and in many other places, but in no place was the apparent damage as great as in Stonington.

The insect causing this trouble was not known at first, but was supposed to be the apple leaf-folder *Ancylus nubeculana* Clem., and the injury was mentioned in a brief note in the last report.* Felt records *A. nubeculana*† as being unusually common and causing some injury in New York State in 1907.

From pupæ reared from the curled leaves in 1909 a few small moths emerged and it proved to be the bud moth *Tmetocera ocellana* Schiff., a well-known apple pest.

The appearance of the opening leaves attacked by the bud moth is shown on Plate XIV, and the caterpillar is also shown considerably enlarged. The apple crop is often ruined because these caterpillars attack the cluster buds and eat out the undeveloped flowers where later the fruit sets. The insect also attacks nearly all other kinds of fruit trees, and feeds upon their buds.

Origin, Distribution and Past Record.

The bud-moth was long known in Europe before it was discovered in this country and probably is a European species. In 1840 it caused considerable damage in Europe and in the following year it was first observed in this country in Massachusetts, where by 1869 it had assumed the importance of an apple pest second only to the canker worm. Records show the occurrence of the insect in Pennsylvania in 1870, New York in 1880, and Nova Scotia in 1885.

Considerable damage is recorded at Rochester, N. Y., in 1887, and in Maine in 1888 and 1890. It was exceedingly injurious

* Report of this station for 1907-1908, p. 847.

† Report, New York State Entomologist for 1907, p. 28.

throughout the northeastern states in 1891 and in Michigan in 1892. The species is now found in Oregon and Idaho, and throughout the northeastern and middle Atlantic states and as far south as Washington, D. C.

General Appearance.

Caterpillar.

In June when the caterpillars are full-grown they are nearly half an inch long and a light chestnut brown color, with head, legs and thoracic shields dark brown or black, smooth and shiny. The body is furnished with five pairs of pro-legs and each segment bears several rather long light-colored hairs.

Chrysalis.

This stage follows the caterpillar stage and is the period of greatest change, though quiescent. The mature caterpillar makes a nest in a tube of dead leaves and there transforms to the chysalis or pupa, which is slightly more than a quarter of an inch in length and of a light-brown color.

Moth.

The adult is a small moth having a wing-spread of about five-eighths of an inch, with general color of dark ash-grey, with

Fig. 4. The Bud Moth. Twice natural size.

broad yellowish cross bands on the front wings and is shown in Figure 4.

Egg.

The egg is disc-like, much flattened, sometimes nearly circular, though usually oval in shape, and is laid upon the underside of a leaf, singly or in small clusters. The eggs are transparent and resemble minute drops of water.

Life History.

In the northern part of its range and probably in Connecticut there is but one brood each season and the insect passes the winter as a half-grown caterpillar hidden in a silken case attached to the twigs. These cases are made early in the fall, sometimes

even in August, though many of the caterpillars continue to feed until October. In the spring the caterpillars appear at the time the buds open, varying with the forwardness of the season, from April 15th to May 15th, and feed on the tender leaves and buds as described above. The leaves are tied together, forming a nest in which the caterpillar lives and feeds. Thus not only are the leaves devoured but the floral organs before developing also are destroyed, thus preventing the tree from fruiting. After feeding for six or seven weeks the caterpillar forms its cocoon and remains in it for about ten days, when the adult moth emerges. Reared specimens emerged in our breeding cages June 10th, and on this date nearly all caterpillars had disappeared. The adults probably live about two or three weeks, during which time they mate and lay eggs for the succeeding generation.

Remedies.

Most writers regard the bud moth as a difficult insect to control and state that the various sprays are unsatisfactory. Our experience at Stonington, however, where many apple trees infested with the bud moth were sprayed with lead arsenate, 1 pound to 10 gallons of water, in the attempt to control the gypsy moth, indicate that this poison will also control the bud moth. Of course the application should be made early—before the blossoms open, and should be repeated after they have fallen. Slingerland advises* two thorough applications before the flowers open. For this purpose lead arsenate is preferable to Paris green.

Where orchards are properly sprayed with arsenical poisons to forestall damage by canker worms, codling moth, tent-caterpillar and other biting insects, there will usually be less trouble from the bud moth, but any efforts in this direction must be thorough and persistent in order to succeed.

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* Cornell Univ. Agr. Expt. Sta. Bull. 107, p. 65.

THE LEOPARD MOTH.

Zeuzera pyrina Linn.

A brief note was printed in the last report of this station (1907-1908, page 847) regarding the occurrence of the leopard moth in Connecticut. Since this note was published considerable evidence has been brought to our attention of serious damage to shade trees, especially elms, by this insect. Pruning of the trees and especially the removal of dead branches reveals the tunnels of the leopard moth larva, which is a borer in the branches and trunks of many species of broad-leaved trees. The illustration on Plate XVI, a, shows one of these galleries, and the infested branch was taken from one of the large elm trees on the New Haven Green. Several specimens of the adult moths have been captured in New Haven, but it was not known until recently that the insect is doing much injury to the trees in Connecticut.

Distribution and Spread in America.

The leopard moth is a European pest, and like many other very injurious insects that we now have to fight, was accidentally introduced into this country, being first noticed in June, 1881, at Hoboken, N. J. Three years later Dr. E. B. Southwick found it injuring trees in Central Park, New York City, and in 1894 pronounced it one of the worst insect pests attacking shade trees. The leopard moth was soon found in other cities near New York and in 1907 Mr. A. H. Kirkland, then superintendent in charge of the work of suppressing the gypsy and browntail moths in Massachusetts, called attention to its presence in Boston. During 1909, the writer was informed of its occurrence in Providence, R. I., and also that many of the fine elms of Cambridge, Mass., were threatened with destruction by this insect. The leopard moth is reported by Professor Smith* as occurring as far south as Long Branch, N. J. As it first appeared in Hoboken, N. J., it will be seen that like many other European insects introduced into this country it has spread northward much more rapidly than in any other direction.

* Report N. J. Agr. Expt. Sta. for 1908, p. 315.

Trees and Shrubs Attacked.

Over eighty species of trees and shrubs have been recorded as being attacked by the leopard moth, and some of them greatly injured. The list includes maples, elms, horse chestnuts, beeches, birches, dogwoods, hickories, oaks and walnuts, their susceptibility being indicated by the order in which they are named. Elms and maples are evidently most commonly attacked from the reports from different cities, but it should be borne in mind that in the Eastern States these trees are far more abundantly planted, both as street trees and as shade trees on private places, than any other kinds of trees. In Central Park, New York City, nearly all deciduous trees and shrubs were to some extent injured by the leopard moth.

Appearance of Infested Trees.

Infested small branches frequently wither and die in mid-summer. Sometimes these will break off, but more often remain, showing as dead twigs above the green foliage. Large scars on the major branches or trunk are caused by the larger caterpillars.

Life History and Habits.

The female is said to lay eggs in the crevices of the bark of the trunk and branches, and as adult moths are taken from early June to late in September this may properly be regarded as the egg-laying season of the insect. In capacity the moths have laid as many as 300 eggs each, and some writers estimate that many more, up to 1,000 may be deposited. The young borers often enter the twigs at the base of a bud, then tunnel along the pith, though in some places the burrow curves outward to the bark. Holes through the bark are made here and there for disposing of the chips, which serve to show where the borers are at work.

The early-hatched caterpillars reach a length of about an inch by the end of the season and have the habit of leaving their burrows, crawling about on the branches of the tree to seek another point of attack, perhaps in a larger branch. Such branches are sometimes nearly girdled by the tunnels, and die or break off at the point of injury. The illustration on Plate XVI, a, shows the chamber where two galleries intersected. Most

writers state that two years are required for the leopard moth to pass from the egg to the adult stage, and the caterpillar transforms to the pupa inside the burrow at a point where the bark has previously been eaten through. The pupa by wriggling is able to work itself partly out of the branch, when the skin splits open and the moth emerges, leaving the empty pupa case protruding from the orifice of the burrow.

The leopard moth appears to confine its attack to the trees of cities and towns and does not cause much damage to trees growing in country districts.

Appearance of the Insect.

The moths are dirty white and semi-transparent, with a yellow or brownish front margin to the wings, marked as shown in

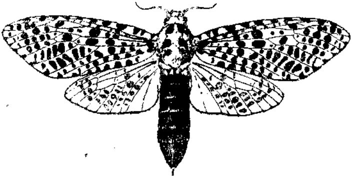

Fig. 5. Female Leopard Moth. Natural size.

the accompanying figure (Fig. 5) with metallic blue dots. The female has a wing-spread of from two and one-half to three inches, and that of the male is about one and three-fourths inches. The markings of the two sexes are similar, except that the dots are more pronounced and the colors brighter in the female.

The eggs are about the size of a pin head and are orange yellow in color.

The caterpillar is pinkish, flesh-colored or dirty white, with a number of dark spots or tubercles, the latter bearing short hairs. Head, thoracic, and anal shields dark brown. Length about two inches.

Remedies.

The position of the caterpillars tunneling in the branches, especially when they are in the tops of large trees, render them exceedingly difficult to reach. If the trees are pruned or other-

wise gone over systematically every year or two the burrows will certainly be detected and can be treated by injecting a few drops of carbon disulphide from an oil can into each and closing the opening with clay, putty, grafting wax or newly-made hard soap. The poisonous fumes penetrate throughout the galleries and will kill the borers therein.

Wilting branches indicate the presence of the borers and should be removed and destroyed. All twigs and limbs that break off during storms should be gathered and burned, thus destroying many of the borers in their tunnels. All female moths should be destroyed wherever found.

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THE PEACH BORER.

Sanninoidea exitiosa Say.

Next to the San José scale the peach borer is probably the most serious insect enemy of the peach in Connecticut. It is found in the United States east of the Rocky Mountains and Canada. It is an American insect and though the peach is not native to America it seems to feed upon it in preference to other hosts.

The Connecticut orchardist therefore is obliged to wage constant and systematic warfare against the peach borer in order to save his trees from destruction, and this brief article is here printed for the benefit of those who are not yet familiar with the work and appearance of the insect and the methods of controlling it.

EFFECT UPON TREES.

Peach trees infested with borers have a sickly appearance, with light green or yellowish foliage, and the uninitiated often

mistake the trouble for an obscure disease of the peach called "Yellows." There is no connection, however, between the two troubles. The borers attack the trunk of the tree at or near the surface of the ground, working in the inner bark and sapwood, usually making a simple chamber just below the surface of the ground, though sometimes running down several inches on a root or working up the trunk above ground for a short distance. The larvæ probably never leave the burrow to go from one tree to another, but keep on enlarging the chamber until they reach maturity, large exudations of a mucilaginous or gummy nature appearing around the trunk. Trees are often entirely girdled and killed, especially where several borers are in them. The peach tree, however, has great ability to recover from the attacks of the borers.

Habits and Life History.

The eggs are laid in midsummer, singly or in groups, on the trunks of the trees near the ground, each female being capable of laying several hundred. About eight days are necessary for the eggs to hatch, and the young larvæ go into the bark sometimes through a crack and sometimes where the bark is smooth, and feed on the inner bark until cold weather, when they suspend operations and hibernate either in the burrow or in a case on the bark. The winter is thus passed as a larva, which goes on feeding in the spring and growing rapidly. As it reaches a large size it makes a larger burrow, and consequently its feeding is much more injurious to the trees than in the fall when it was very small. Great masses of gum exude from the injuries and often the larvæ and particularly the pupæ are enveloped in the masses of gum, which are an indication of the presence of borers in the tree. In June the larvæ become full grown and leave their burrows and pupate in brown cocoons which they make for themselves at the surface of the soil. About three weeks are spent in this stage; then the adult comes forth. The moths are found flying late in June and during July and August. There is but one brood each season.

Food Plants.

Though a native American insect, it did not at first appear to be much of a peach tree pest, but it has been recorded as

attacking the peach for at least one hundred and fifty years. Sargent states* that the wild black cherry is believed to have been the native food plant of this insect. In 1823, Harris reared the peach borer from cultivated cherry in Massachusetts and thirty years later Fitch found it attacking his plum trees in New York. In 1880, Fuller ascribed the cause of death of his dwarf flowering almond shrubs to this borer. In Connecticut the writer has taken what appeared to be the larvæ of the peach borer from the base of the trunk of the wild black cherry. But as the peach is now cultivated extensively in Connecticut it is only as a pest of the peach that this insect is commonly known.

Appearance of Insects.

The adults of the peach borer are wasp-like moths belonging to the family *Sesiidæ,* commonly called "clear-wings." The female is somewhat larger than the male and has a wing-expanse varying from one to one and a quarter inches. The male has a wing-expanse of about an inch, and is of a bright metallic blue color with yellow markings; both front and rear wings are transparent, with a discal cross mark on the fore wing. The female has transparent rear wings, but the fore wings are opaque blue-black, and there is an orange-colored band encircling the fourth segment of the abdomen. Specimens occur having two orange bands instead of one, the fifth abdominal segment also being orange-colored. The appearance of both sexes is shown in Plate XV.

The egg is minute, oval, brown in color, with the whole surface finely reticulated.

The fully grown larva is about an inch long, rather thick, white, with light brown head and is shown on Plate XV. The pupa is also about an inch long, brown in color, and enclosed in a rough cocoon made up of particles of bark and excrement fastened together with gum and lined with silk.

Remedial Treatment.

Many washes and mechanical devices have at various times been originated for preventing the attacks of the peach borer. Some of these devices are not without value; most of them have

* Sylva of North America, vol. 4, p. 11.

long since been discarded by the practical peach grower, who depends upon a careful inspection at least twice a year to destroy the borers. If the trees are examined in September, and again in April or May, and the borers dug out and killed, the expense is probably not greater than any other form of treatment, and is certain to be more effective.

MOSQUITO BREEDING AREAS EXAMINED AT THE REQUEST OF HEALTH OFFICERS.

Early in May the New Haven County health officer, Mr. Carleton E. Hoadley, asked the state entomologist to visit a small pond near Ansonia owned by the Ansonia Water Company, which had been complained about as a source of malarial mosquitoes, malaria having been prevalent the previous season. The visit was made May 12th in company with Mr. Hoadley. A concrete dam had been built, and some ground had been allowed to remain flooded for the purpose of rotting the turf and weeds preparatory to cleaning out. Undoubtedly the pond would breed mosquitoes and probably a great many of them later in the season, but at the time of the visit it was rather early to find wrigglers. The Ansonia Water Company desired to learn about the best treatment to prevent mosquitoes from breeding there. The following brief report was sent to the president of the Water Company:

May 12th, 1909.

"MR. THEODORE BRISTOL, President,
ANSONIA WATER CO.,
Ansonia, Conn.

Dear Sir:—

I visited Ansonia this morning in company with Mr. C. E. Hoadley of New Haven, and examined the small lake where you have built a dam on the hill east of the city. On the south side of this flooded area there is considerable brush, and any attempt to use oil on this would probably not be successful until the brush is cleared off, because in applying the oil it would be quite difficult to cover the surface of the water without wasting a good deal of material on the bushes, which would also interfere with thorough work. If the problem was my own, I should draw off the water, or lower it a foot or so, and cut this brush around the edge of the pond back as far as, or perhaps beyond, the present water line. If you expect to leave the water in it, it would be well to see that it is heavily stocked with some kind of carnivorous fishes, preferably those which feed

near the surface of the water,—pike, pickerel, top minnows, and several other kinds which would answer the purpose. They will devour the mosquito larvæ in the water wherever they can reach them, but in the grass and bushes around the edges, where the water is shallow, it may be impossible for them to reach the mosquito larvæ, and therefore such areas may be prolific breeding places for mosquitoes. From a cursory examination of the place I should feel safe in pronouncing it a place where mosquitoes would breed under ordinary conditions. If the edges could be deepened so that the banks would be abrupt, and kept clean, there would probably be no need of oiling at all, but of course at present the water is shallow and vegetation is apt to grow through it to some extent.

Kerosene can be used for oiling, and should be applied at the rate of one fluid ounce to fifteen square feet of space. It is applied preferahly hy means of a spray pump, or at least some force pump which will enable one to throw it out for some distance upon the surface of the water. It will spread itself, but it is always well to distribute it as much as possible in applying it. It is always best to put the property in such condition that it will he permanently free from such troubles, because the operation of oiling needs to be repeated once in ten days or so often that in a few years the total expense amounts to even more than the permanent improvement. I shall be glad to answer any further questions in regard to the matter.

Very truly yours,

W. E. BRITTON,

State Entomologist."

Mr. Bristol replied immediately as follows:

"We are pleased to acknowledge receipt of your letter of May 12th, and will follow your suggestions as to drawing off the pond and clearing off the brush on the Parker pond which you examined, because we can see from your statement that you think it is a practical way to treat this proposition."

Later in the season a similar request came from Mr. Hoadley regarding the meadows near the city of Derby, where the new railroad tracks had cut off the natural drainage, forming pools of water more or less stagnant. The place was visited August 12th, and the state entomologist in company with Mr. Hoadley and Dr. J. H. Townsend, secretary of the State Board of Health, were met in Derby by Dr. F. A. Elmes, health officer, and Dr. A. W. Phillips of the State Board of Health, both of Derby.

A choked ditch and two pools between the old Derby railroad and the present location of the Naugatuck railroad contained many wrigglers or larvæ of malarial mosquitoes. As the

health officer wished a statement from this office to submit to the officials of the railroad company the following was sent to him:

Aug. 12, 1909.

"DR. F. A. ELMES,
Derby, Conn.

Dear Sir:—

I herewith submit to you a brief statement of the conditions found on the Derby meadows when examined this morning in company with Dr. J. H. Townsend, secretary State Board of Health, Mr. C. E. Hoadley, County Health Officer, Dr. Phillips, and yourself.

Larvæ or wrigglers of the malarial mosquito (Anopheles), were found in the choked ditch running from the old layout of the Derby railroad towards the present location of tracks of the Naugatuck division; also in two large pools near the present tracks, where the construction work formed a dam cutting off the natural drainage.

In the light of our present knowledge, any pool of stagnant water where these mosquitoes breed must be considered a menace to the health of the people in that vicinity, and should be abated. Permanent treatment, such as filling or draining, is always to be advised rather than the temporary expedient of oiling the surface, which in order to be effective must be repeated every ten days through the mosquito season.

Very truly yours,

W. E. BRITTON,

State Entomologist."

FUMIGATING BUILDINGS WITH HYDROCYANIC ACID GAS.

By B. H. Walden.

In the Sixth Report of the State Entomologist (1906, page 291) is an account of fumigating a dwelling house with hydrocyanic acid gas to kill the bedbug, *Klinophilos lectularia* Linn. This house has been carefully watched for the reappearance of the pest, but not a single specimen of this insect has been found.

Since the publication of the article mentioned above the writer has had charge of fumigating six buildings with hydrocyanic acid gas. Five of the buildings were infested with bedbugs and the sixth, a grain and feed store, was infested with grain insects, principally the saw-toothed grain weevil, *Silvanus surinamensis* Linn. Rats and mice were also doing much damage, especially by gnawing through the bags, allowing the contents to leak out.

As there have been many inquiries received regarding the fumigation of buildings, the operation of fumigating this feed store is herein described.

The building was of brick, 38 x 88½ feet and 4 stories high. Between the first and second story the height was 12½ feet; between the second and third and third and fourth, 11 feet. Between the fourth floor and roof the average was about 5½ feet.

There were comparatively few windows in the building, these being only in the front and back. At the front on the first floor was the office, and on the second floor a room 18 x 20 feet was partitioned off, the remainder of the floor space being used to store the grain; a portion being loose in bins and the remainder stacked in bags.

The fumigating was done on Thursday evening, Friday being a holiday, and the building remained closed until about 8:30 Saturday morning.

The following formula was used, the quantities being for each 100 cubic feet of space:—

Potassium cyanide, 98% C. P.	1 oz. by weight.
Sulphuric acid, commercial	1 oz. by measure.
Water	2 ozs. " "

Below are given the cubic contents of each floor, the amount of cyanide and number of generating dishes used:—

1st floor	42,037 cu. ft.	420 ozs. cyanide.	7 generators.
2d floor	36,992 " "	370 " "	7 "
3d floor	36,992 " "	370 " "	6 "
4th floor	18,498 " "	188 " "	4 "
2 cellars	.....	92 " "	4 "
	134,519 cu. ft.	1,440 ozs., or 90 lbs.	

The cyanide for each generator was weighed and placed in a paper bag, after which a bag was placed near the spot where each generator was to be located. The generating dishes, which were cheap wooden water and candy pails, were charged by putting in each the proper amount of water and then slowly stirring in half as much acid. (The water should always be put in first.) These were then placed in position. The operation was made as simple as possible by using equal amounts in all generators on the same floor, the generators of course being placed so as to diffuse the gas as evenly as possible. When everything was ready two men started at the top to drop the bags of cyanide into the generating dishes. The operator should always start at the top of the building and work down, always leaving the generators nearest the exit until the last. In case the cellar has no door leading out into the open air, the bags should be suspended over the generators with strings and arranged so that they can be lowered from the first floor. It is not safe for the operator to go into the cellar and start the generators going and then go to the first floor to work with gas generating above and below him.

The building was locked and left closed for about 40 hours. The doors and a number of the windows were then opened from the outside and the first floor was soon aired so that the building could be entered. As it was not necessary to use the other floors, these were aired gradually, one at a time.

Many dead mice were found scattered over the floors, and a few dead rats, although many of the rats probably escaped, as it is doubtful if the gas would penetrate their burrows, which may have extended for some distance beneath the foundation of the building.

The owner was satisfied with the treatment, and a subsequent visit showed very little recent damage from mice and rats, and no live grain weevils were found.

In each of the buildings fumigated practically the same method was employed, and the formula mentioned above was used.

One of the principal troubles in the work was to get suitable dishes for generators. Dishes made of the iron stone china are satisfactory and the treatment does not injure them, but the heat generated will destroy the glazing of ordinary glazed earthen ware. In one case where the expense was no object the owners purchased a sufficient number of 2 gallon fruit jars for generators. These were ideal for the purpose but cost about 30 cents apiece, increasing materially the cost of the operation.

In fumigating the feed house above mentioned, and in one of the dwelling houses, cheap wooden pails were used. These were purchased for about 15 cents apiece, and were fairly satisfactory, but would sometimes leak, even though thoroughly soaked with water beforehand. If the pails could be treated so as not to leak, they would make very satisfactory cheap generators.

Two of the dwelling houses were completely furnished when fumigated, and no damage was noted to draperies, gilt picture frames, brass bedsteads, etc. Certain gold and brass alloys showed some tarnish, but this seemed to rub off readily.

Each of the buildings which we have fumigated has been closed over night, and where possible it is advisable to do this, but fumigating for 2-3 hours would probably prove effective.

We consider that fumigating with hydrocyanic acid gas is the most thorough treatment that can be given for household insects. This is one of the most deadly gases known, and great care must be taken throughout the whole operation. The house should be thoroughly aired before entering, and anyone sleeping in a house recently fumigated should see that there is abundant ventilation until all traces of the gas are out of the building.

MISCELLANEOUS INSECT NOTES.

TOBACCO BUD WORM IN CONNECTICUT.

About September 15th some unusual green caterpillars were found feeding upon the experimental tobacco plants, growing on the Station grounds. These were placed in breeding cages and

supplied with food. One pupated September 15 and the others a few days later. On October 11th one adult moth emerged from the cocoon, and two appeared October 21st. On obtaining the adults, we were able to identify the species as *Chloridea virescens* Fabr., formerly known as *Heliothis rhexiae* S & A and called the "true bud worm" to distinguish it from *Heliothis obsoleta* Fabr. which is called the "false bud worm."

The adult of *Chloridea virescens* is a greenish moth having a wing expanse of one and one-half inches and is shown in figure 6. Each fore wing is transversed by the lighter bands.

Quaintance mentions* this species as attacking the tobacco crop in Florida but states that it is less troublesome than *Heliothis*

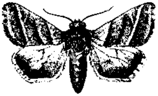


Fig. 6. The Tobacco Bud Worm Moth. Natural size.

obsoleta. Howard† states that it has not been noted in tobacco fields north of Maryland. In Dyar's List of N. A. Lepidoptera the distribution of this species is given as "United States."

CANKER WORMS.

Much damage was done locally to orchard and shade trees throughout Connecticut in 1909, but the warning was given, the danger pointed out and relief measures recommended in the last report of this office (see Report of this Station for 1907-1908, page 777), to which the reader is referred for a full account of this insect. In spite of the warning, however, there were scores of good apple orchards stripped of their leaves in May and looking as if a fire had run through them. However, there were orchards scattered here and there attacked by Canker Worms which were carefully sprayed by the owners and all damage prevented; these served as excellent object lessons to the communities in which they are located.

On account of the great damage caused by Canker Worms in 1909, and the abundance of adults in the late fall and later the

* Florida Agr. Expt. Sta. Bull. 48, p. 184, 1898.

† Year Book U. S. Dept. of Agr. for 1898, p. 132.

eggs on the trees, it is reasonable to expect serious injury again in 1910, and the only treatment that can now be given is to spray the foliage in May, using preferably lead arsenate at the rate of about 3 lbs. in 50 gallons of water.

THE GREENHOUSE LEAF-TYER.

On January 17th Mr. Wm. J. Rowe, gardener to Mr. Joel Sperry of Whalley Avenue, New Haven, Conn., brought to the Station some caterpillars which were injuring greenhouse cinerarias and daisies by devouring the leaves. The following description of the larva and the accompanying drawing (figure 7) were prepared by Mr. Caffrey.

Average length 14mm. Average width 3mm. General color, light green along dorsal surface with a light greenish yellow

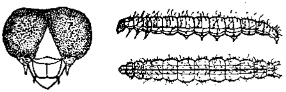


Fig. 7. The greenhouse leaf-tyer. Side and dorsal view of larva two and one-half times natural size. Also front view of head, greatly enlarged.

tinge on lateral and neutral surfaces. A narrow dark green median stripe extends along the dorsal surface from behind the head to the last segment. Four rows of bristles on each side of mid-dorsal line extending length of body with one bristle on each segment except the row next to mid-dorsal line on each side, which has two bristles on each segment. Head has a light brown tinge with darker brown spots.

On January 21st one of the caterpillars spun a cocoon and transformed to the chrysalis or pupa stage and the others soon followed suit. The first moth emerged on Feb. 10th. The insect proved to be *Phlyctænia ferrugalis* Hubn. (*rubigalis* Guen) and is illustrated on Plate XVI, b.

This species is known as the greenhouse leaf-tyer and according to Chittenden* has caused considerable damage to greenhouse and field plants, including vegetables, during the past few years. The larva works on the under side of the leaves, often fastening

* Bureau of Entomology, Bull. 27, N. S., p. 7.

two together with silken threads or curling the edge of the leaf on which it may be feeding, and enclosing itself in a thin web.

The adult is a slender species with a wing-expanse of about three-fourths of an inch and of a pale reddish brown color, with inconspicuous markings. It is said that there are at least two and perhaps more annual generations out of doors, and more—probably five or six—in greenhouses. There are published records of the occurrence of this insect throughout the eastern states and in California.

The list of food plants includes cabbage, beets, celery and tobacco, rag weed, hedge mustard, and a large number of greenhouse and outdoor ornamental plants.

The whitish translucent eggs are deposited either singly or in masses of eight or ten on the under side of the leaf; they hatch in a period varying from five days to nearly three weeks. The larval period lasts from three to five weeks according to temperature and the pupal period usually about two weeks.

The adults fly just before sundown and usually rest during the day on the under side of the leaves of the plants, upon which the larva feed. When at rest the wings are folded in the manner common to most Pyralid and Deltoid moths.

Wherever much damage is done or the caterpillars are sufficiently abundant to cause apprehension, the plants may be poisoned by spraying them with lead arsenate or by dipping them into the liquid. The poison should be mixed at the rate of about one pound in ten gallons of water.

Where spraying is practiced it is necessary to apply the poison to the under sides of the leaves. Chittenden advises* fumigating the house in serious infestations and gives directions for carrying out the treatment. For general fumigation from one-tenth to fifteen-hundredths of a gram of 98% potassium cyanide for each cubic foot of space should be used.

STRAWBERRY CROWN GIRDLER ATTACKING YOUNG HEMLOCKS.

On June 16th samples of injured hemlock trees were brought to the station from a nursery in New Haven. The trees were between twelve and eighteen inches in height and had been growing in nursery rows for one and two years. They had shown signs of unthriftiness by turning brown and dropping their leaves.

* Idem, p. 20.

Some failed to make any growth. On examining the roots it was found that insects were at work in the bark of the main stem and larger roots. Larvæ pupæ and adults of a small beetle were found in the bark and in the soil near the tree. Of 4,000 young trees about 200 were destroyed by this insect, which proved to be the Strawberry Crown Girdler *Otiorhynchus ovatus* Linn. of the family Otiorhynchidæ and closely allied to the curculios. It usually feeds upon the roots and crowns of strawberry, grass and many other plants. Though I have not found Hemlock mentioned as a food plant, it is known to be a general feeder, and the larvæ of another and much larger species of the same genus *O. sulcatus* Fabr. are known to feed in Hemlock bark. The injured hemlock trees were from western nurseries and were grown in frames a year before setting and were near the spot where strawberries had been growing the preceding year, which possibly may explain the attack.

The Strawberry Crown Girdler is not a native to America but occurs in northern Asia and Europe and probably came to us from Europe. It has also been called the strawberry weevil, the pitchy-legged Otiorhynchus, and in certain localities has acquired the name of "graveyard bug," probably because it was abundantly feeding upon the grass in a cemetery. It occasionally causes serious damage to strawberries in Connecticut by eating the roots and crowns of the plants. Remedial treatment with insecticides is rather unsatisfactory and cultural methods must be relied upon chiefly to control this insect. As the larvæ feed normally upon the roots of grass and various plants, Cooley suggests* that "the remedial measure that seems to promise most is so managing the soil that where it is desired to set out the field to strawberries the beetles will have previously starved out."

Miss Patch reports† this beetle as being abundant in houses in several localities in Maine in 1905. Though housekeepers were alarmed, the Strawberry Crown Girdler does no harm in the house. It simply seeks a hiding place, though not entirely for hibernation, and the houses afford a convenient place.

Miss Patch gathered several hundred adult beetles and confined them to learn something about their feeding habits. She

* Montana Agr. Expt. Sta. Bull. 55, 1904.

† Maine Agr. Expt. Sta. Bull. 123, 1905.

then collected leaves and flowers of various plants and placed before them. In this manner they were observed to feed to a greater or less extent upon about fifty different kinds of trees and plants, not including, however, hemlock.

The adult beetle is nearly one-fourth of an inch long and varies from light reddish brown to nearly black in color. Like some other allied species, the Strawberry Crown Girdler has thick wing covers but no wings. Consequently it is not able to fly and does not spread very rapidly.

Fig. 8. The Strawberry Crown Girdler. Enlarged three times.

This insect is shown in figure 8. The Station collection contains specimens of this beetle from Colebrook, Windsor, Waterbury, Stratford and New Haven.

WHITE GRUBS IN GRASS LANDS.

Reports have been received from different parts of the state of injury to grass land last season by white grubs which eat off the roots. The damage becomes noticeable late in summer, after the hay crop has been harvested, especially if two or more seasons of drought at this time have occurred. The roots are devoured so that the turf can be peeled or scraped from the soil in large areas; in former years I have seen acres in this condition in the State of New Hampshire, and in some fields the ground was literally torn up by skunks which dig to get the grubs for their food. Give the skunks credit for doing a little good. The localities reported in Connecticut are Oxford, Salem and Meriden. One man asks if the grubs will be troublesome next season, and if it will be safe to plant corn, strawberries or other hoed crops on the land next year. Though it is scarcely safe to prophesy regarding the occurrence or absence of insect pests, there are certain general laws and conditions which we may consider. For instance, the white grub is the larva of the "May beetle" or "June beetle," shown in figure 9, of which

there are several species, and three years are required for the insect to pass through its entire period of development from the egg to the adult beetle. Grass lands are seldom injured by the grubs except when they are numerous and nearly full grown. It is fair to assume, therefore, that those grubs doing the damage in the summer of 1909 will not feed another season, but will transform or perhaps have already transformed, and that

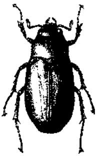


Fig. 9. A common "June Beetle" *Lachnosterna fusca* Froehl. Natural size.

the beetles will emerge in May and June to lay eggs for the succeeding generation. We may expect the beetles to be very abundant. In planting the land to other crops, it is advisable to give it a good plowing and thorough harrowing with a disk or cut-away harrow, and these preparatory operations will kill many of the insects before they emerge.

A word as to remedies. It has often been advised that heavy applications of common salt, lime, kainit or muriate of potash be applied to the grass land as soon as the damage is first noticed to kill the grubs. It is a question whether this practice is worth while, though the application of any good fertilizer is of value as plant food. Usually it is best to plow the ground, and sometimes a crop of Hungarian grass or millet can be grown the same season. In other cases it can be sown to rye. If no crop is put upon the land immediately, it is best to plow the ground late in the fall, as many of the grubs will thus be exposed and devoured by crows or blackbirds or killed by the elements. If the field can be pastured with pigs, they will destroy most of the grubs and beetles.

WHITE ANTS INJURING A HOUSE IN SOUTH NORWALK.

Specimens were received from South Norwalk on April 19th with the report that they were eating through the solid wood

of the construction timbers and finish boards of a dwelling house. The specimens were a common insect—known as white ant *Termes flavipes* Kollar, though not an ant at all and not closely related to the ants, but given the popular name of white ant on account of its appearance and habits. There are several species of white ants in the tropics, and some of them do a great amount of damage. *T. flavipes* is rather common in Connecticut, often nesting in old stumps, in fence posts, or in buildings. The writer has noticed large numbers of individuals swarming along the sidewalks, where they had emerged from the strip of board laid to hold the edge of the tar walk. One season they were nesting in the board walks in the Station greenhouse. The greenhouse was afterward fumigated with hydrocyanic acid gas and the white ants disappeared. Carbon bisulphide is perhaps the best remedy if it can be poured into the nest and the opening stopped.

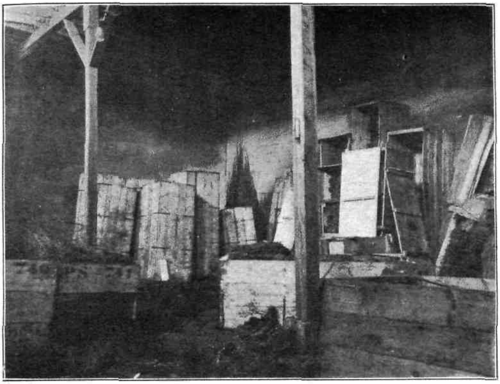
GREEN ROSE CHAFER IN PACKAGE OF NURSERY STOCK IMPORTED FROM EUROPE.

When inspecting some ornamental nursery stock imported from Holland at a nursery in New Haven in April, 1909, a living specimen of *Euphoria* (*Cetonia*) *aurata* Linn. was found in the packing. It is needless to say that the specimen was immediately placed in the cyanide bottle and now reposes in the Station collection. This beetle is a large and handsome species of bright metallic green color marked crosswise with small whitish spots or streaks and is shown on Plate XVI, c.

The green rose chafer is considered a pest in Europe—the grubs feeding upon the roots of strawberries, grass and other plants and the adult beetles attack various flowers, such as strawberry blossoms and roses.

Eggs are laid in the ground where the grubs feed for two or three years. The grubs are nearly an inch and a half long when full grown and are of a dirty white color with the posterior extremity grey and with a yellow head. They make their pupal cases in the soil in the same manner as our white grubs, which they closely resemble.

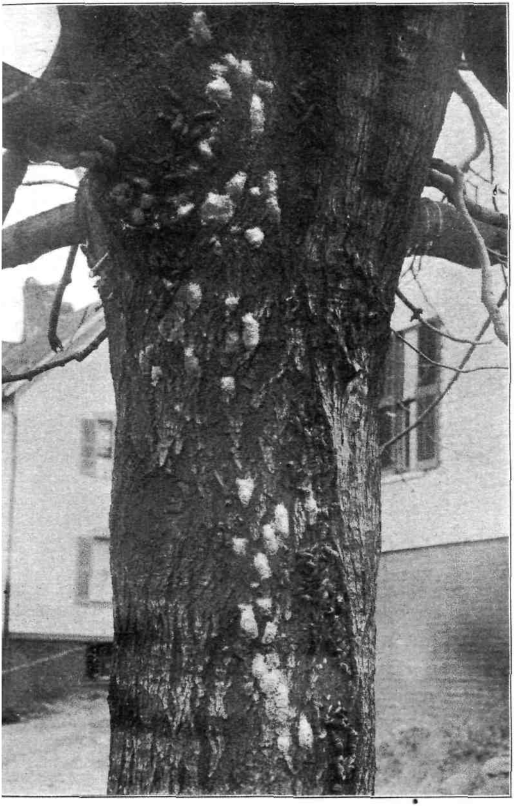
A brief account of the green rose chafer is contained in "Manual of Injurious Insects and Methods of Prevention" by Eleanor A. Ormerod, London, England, 1890.



a. Showing boxes of imported stock in packing shed.

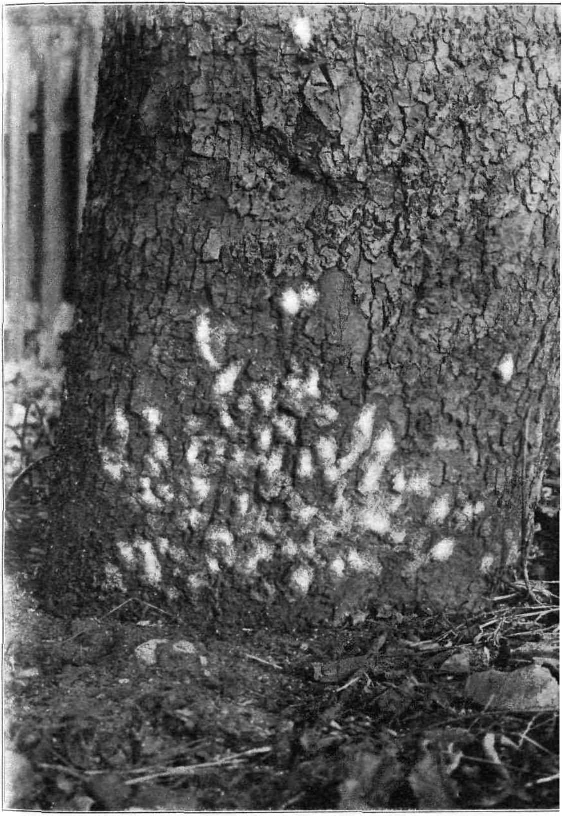
b. Inspecting stock at the nursery.

INSPECTION OF IMPORTED NURSERY STOCK.



Egg-clusters on maple street-tree: about 300 were counted on this tree.

GYPSY MOTH AT WALLINGFORD.



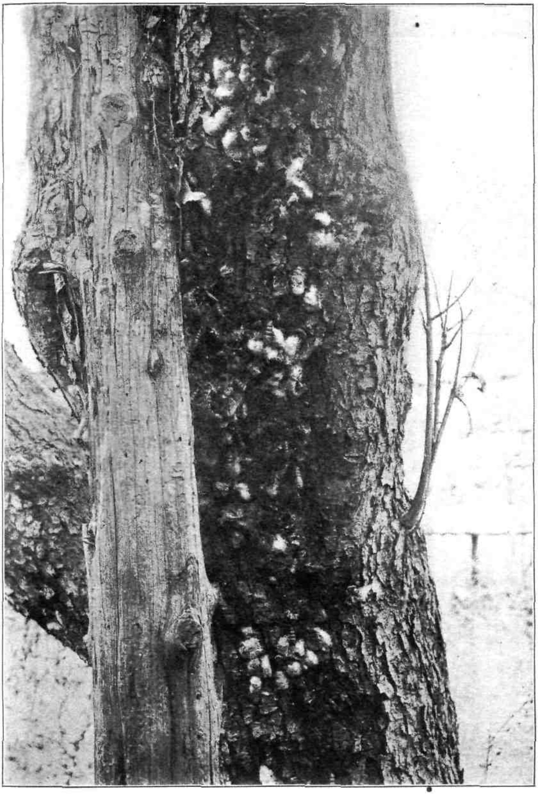
GYPSY MOTH EGG-CLUSTERS ON BASE OF APPLE TREE.

Nearly 300 egg-clusters were found on these trees.

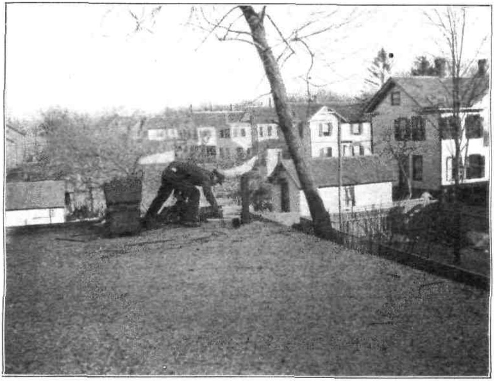
INFESTED WILLOWS AT WALLINGFORD.

Tree, building, fences and tinware were infested with egg-clusters.

CONDITIONS IN AN INFESTED BACKYARD AT WALLINGFORD.



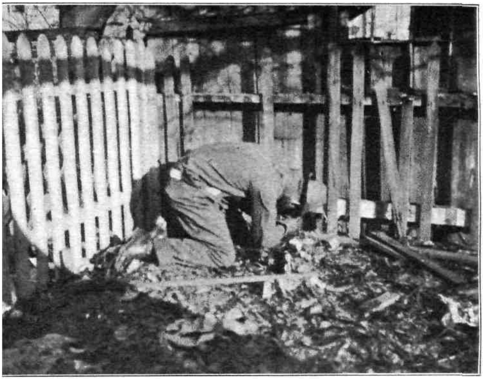
EGG-CLUSTERS AND OLD COCOONS ON APPLE TREE, WALLINGFORD.



a. Nearly fifty egg-clusters were found on this roof.

b. General view of one of the worst-infested backyards.

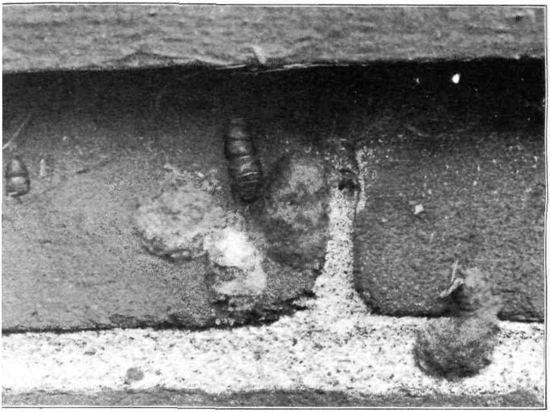
GYPSY MOTH WORK, WALLINGFORD.



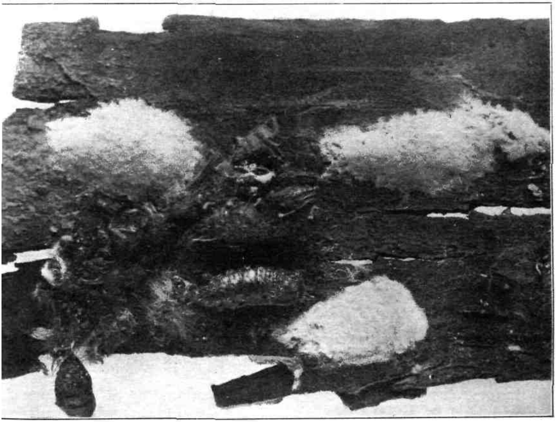
a. Examining the fence and destroying egg-clusters.

b. This pile of kindling wood contained about fifty egg-clusters.

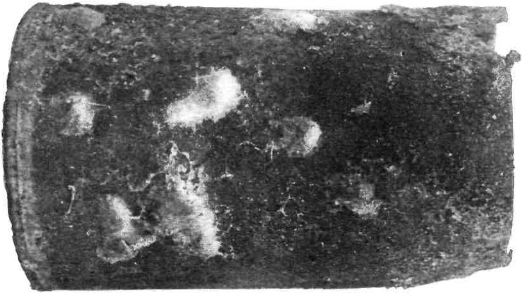
DESTROYING GYPSY MOTH EGGS, WALLINGFORD.



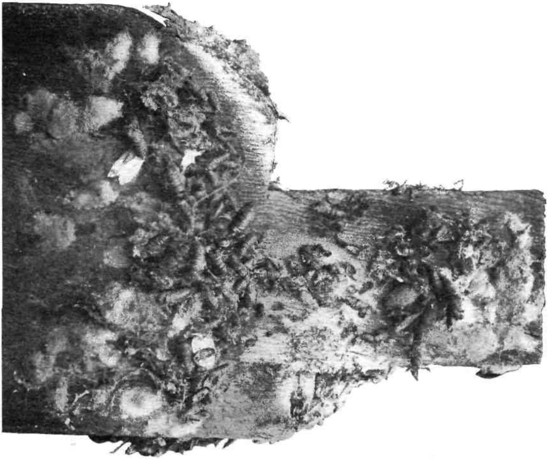
a. Egg-clusters on brick underpinning.



b. Egg-clusters on inside of loose hickory bark.



a. This coffee can had 21 egg-clusters on and in it.

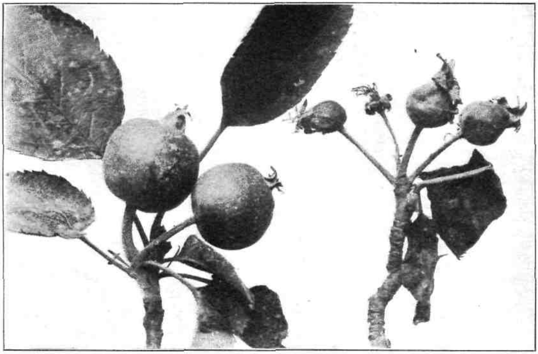


b. Dead moths, egg-masses and old cocoons under board lying upon the ground.

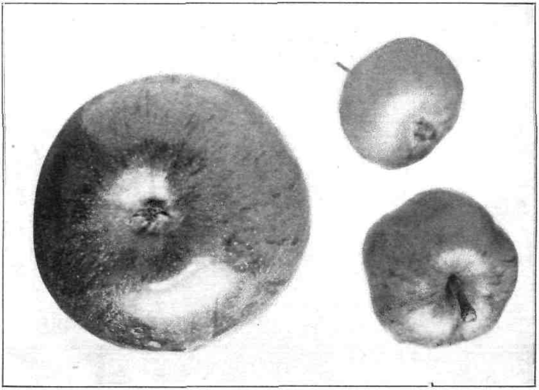
WALLINGFORD GYPSY MOTH INFESTATION.

PLATE XI.

DESTROYING GYPSY MOTH EGG-CLUSTERS AT WALLINGFORD.



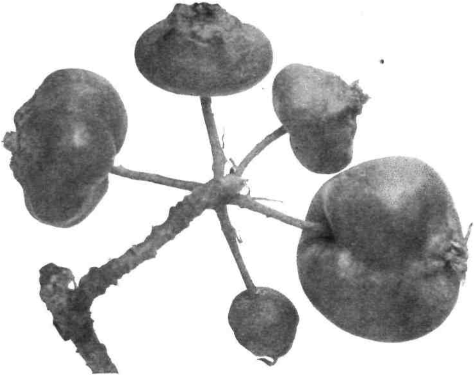
a. Cluster at right badly infested, showing difference in size from normal fruit at left, not infested.



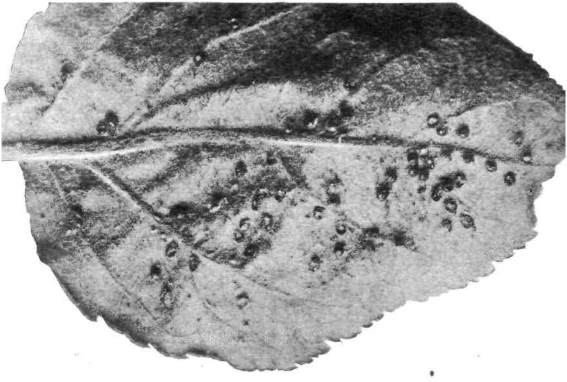
b. Normal size of fruit at left; those at right checked by attack of aphis.

ROSY APPLE APHIS.

PLATE XIII.



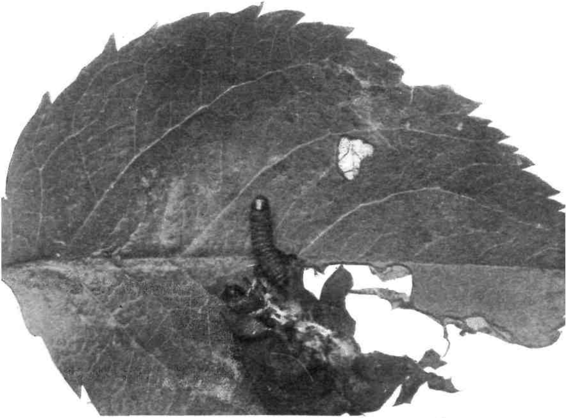
a. Badly infested cluster, causing stunted and irregular fruit.



b. Apple leaf showing parasitized aphids twice natural size.

ROSY APPLE APHIS.

a. Young apple leaves infested by bud moth, natural size.



b. Apple leaf and bud moth caterpillar, twice natural size.

BUD MOTH.

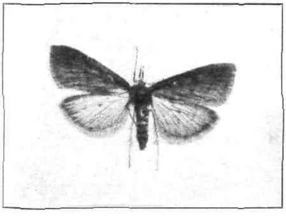
a. Larva in its burrow in young peach tree.

b. Female peach borer moth, twice natural size. (After Beutenmuller.)

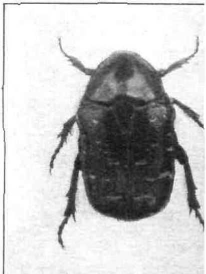
c. Male peach borer moth, twice natural size. (After Beutenmuller.)

PEACH BORER.

a. Elm branch showing galleries of the Leopard moth larva.



b. Adult of the Greenhouse Leaf-Tyer.
Twice natural size.



c. European Green Rose C
Twice natural size.

EUROPEAN GREEN ROSE CHAFER, GREENHOUSE LEAF-TYER AND WOR
OF LEOPARD MOTH.

PART V.

Report on Commercial Fertilizers, 1910.

By E. H. JENKINS, *Director*, and JOHN PHILLIPS STREET, *Chemist in charge of the Analytical Laboratory.*

This station is required by statute to analyze yearly at least one sample of every commercial fertilizer which is offered for sale in the State at a price of more than ten dollars per ton.

The Station is also required to publish these analyses yearly.

The duties of manufacturers and dealers in fertilizers have been set forth on pages 1 and 2 of this biennial report.

OBSERVANCE OF THE FERTILIZER LAW.

During 1910, forty-one individuals and firms have entered for sale in this State three hundred and thirty-eight brands of fertilizers, viz:

Special manures for particular crops	153
Other nitrogenous superphosphates	101
Bone manures and "bone and potash"	26
Fish, tankage, castor pomace and chemicals	54
Unclassified	4
	338

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited one hundred and seven towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	7
Hartford County	36
Tolland County	8
Windham County	9
New London County	8
Middlesex County	10
New Haven County	16
Fairfield County	13
	107

In these places seven hundred and six samples were taken.

The agent did not find on sale the following brands which had been entered for sale in the State: American Agricultural Chemical Co.'s H. G. Fertilizer with 10 per cent. Potash, Bowker's Highly Nitrogenized Mixture, Special Crop Grower, Essex Grass and Grain, New England Tankage, Parmenter & Polsey's Potato Grower, Swift's Lowell Muriate of Potash. Therefore no analyses of these brands appear in the following pages.

Explanations regarding the method of sampling will be found on page 11 of this report.

ANALYSES OF FERTILIZERS.

A classified list of the samples analyzed is given below and the results are given in detail in the following pages.

DESCRIPTIONS AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages were drawn by the Station Agent unless the contrary is stated; the analyses were made by the methods adopted by the Association of Official Agricultural Chemists, and the results are always expressed in percentages, or parts per hundred by weight of the material examined.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

1. *Containing nitrogen as the chief active ingredient.*

	Number of Samples.
Nitrate of soda	22
Dried blood	2
Cotton seed meal	157
Castor pomace	6

* The analyses of fertilizers included in this chapter have been made by Mr. Street, chemist in charge, with the assistance of Messrs. Bailey, Morrison, Roe and Shepard, station chemists, and of Mr. Lange. The results have been discussed by the director.

	Number of Samples.
2. *Containing phosphoric acid as the chief active ingredient.*	
Phosphate rock, basic slag, bone ash, etc.	7
Soluble phosphates	17
3. *Containing potash as the chief active ingredient.*	
Muriates and sulphates	24
Kainit	3
Vegetable potash	1
4. *Containing nitrogen and phosphoric acid.*	
Bone manures	32
Tankage	14
Fish	22
5. *Mixed fertilizers.*	
Nitrogenous superphosphates	282
Home mixtures	22
6. *Miscellaneous fertilizers, manures and amendments*	50
Total	661

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of soda is mined in Chili and purified there before shipment. As offered in the Connecticut market, it contains about 15.50 per cent. of nitrogen, equivalent to 94.1 per cent. of pure sodium nitrate. The other usual constituents are moisture and small quantities of common salt and Glauber's salt.

Shipments differ somewhat in composition, as is shown by the twenty-two samples which have been analyzed, as follows:

24500. Sold by Coe-Mortimer Co., New York. Sampled by Thos. Griswold & Son, Wethersfield.

24163. Sold by Coe-Mortimer Co. Sampled by L. B. Sperry, New Haven.

24516. Sold by Buffalo Fertilizer Co., Buffalo, N. Y. Sampled by S. L. Tuttle, Wallingford.

24286. Sold by Bowker Fertilizer Co., New York. Sampled by John Gotta, Portland.

24326. Sold by Bowker Fertilizer Co. Sampled from stock of A. Grulich, Meriden.

24429. Sold by E. D. Chittenden, Bridgeport. Sampled from stock of D. L. Clark, Milford.

24485. Sold by Nitrate Agencies, New York. Sampled from stock of Apothecaries Hall Co., Waterbury.

24482. Sold by Atlantic Fertilizer Co., Baltimore. Sampled from stock of L. Harkavy, Leonard's Bridge.

24315. Sold by Nitrate Agencies. Sampled from stock of Apothecaries Hall Co.

24229. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled from stock of T. W. Ryan, Stratford.

24355. Sold by Wilcox Fertilizer Co., Mystic. Sampled from their stock.

24347. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Connecticut Valley Orchard Co., Berlin.

24350. Sold by Swift's Lowell Fertilizer Co., Boston. Sampled from stock of C. W. Lines Co., New Britain.

24310. Sold by Coe-Mortimer Co. Sampled from stocks of F. S. Platt Co., New Haven, and F. S. Bidwell & Co., Windsor Locks.

24664. Sold by Rogers Mfg. Co., Rockfall. Sampled from their stock.

24349. Sold by National Fertilizer Co., New York. Sampled from stock of J. A. Glasnapp, West Cheshire.

24318. Sold by Sanderson Fertilizer Co., New Haven. Sampled from their stock.

24291. Sold by Coe-Mortimer Co. Sampled by J. F. Shepard, New Haven.

24237. Sold by Nitrate Agencies Co. Sampled from stock of S. D. Woodruff & Sons, Orange.

24400. Sold by Patrons' Exchange, Danielson. Sampled from stock of C. R. Treat, Orange.

24392. Sold by American Agricultural Chemical Co. Sampled from stock of Conn. School for Boys, Meriden.

24423. Sold by American Agricultural Chemical Co. Sampled from stock of Andrew Ure, Highwood.

The per cent. of nitrogen in these samples ranges from 15.0 to 15.48 and averages 15.24.

The retail cost of nitrogen ranges from 15.0 to 17.8 cents per pound, the average being 16.1 cents.

The nitrogen of nitrate of soda is unquestionably the most quickly and fully available form which is accessible and this year it has been the cheapest. For quick action, particularly on such crops as grain, grass and potatoes which make a large part of their growth when the soil is still too cold for the active decay and nitrification of organic forms of nitrogen, nitrate of soda is especially valuable.

Analyses of Nitrate of Soda.

Station No.	**24500**	**24163**	**24516**	**24286**	**24326**	**24429**	**24485**	**24482**	**24315**	**24229**	**24355**
Percentage amount of											
Nitrogen found	15.00	15.44	15.36	15.22	15.32	15.48	15.18	15.38	15.00	15.00	15.48
Nitrogen guaranteed	15.0	15.6	....	15.2	15.0	15.0	15.0	15.0	15.0	15.7	15.0
Cost per ton	$45.00	47.00	47.00	47.12	48.00	49.00	48.00	49.00	48.00	48.00	50.00
Nitrogen costs cents per pound	**15.0**	**15.2**	**15.3**	**15.5**	**15.7**	**15.8**	**15.8**	**15.9**	**16.0**	**16.0**	**16.1**

Station No.	**24347**	**24350**	**24310**	**24664**	**24349**	**24318**	**24291**	**24237**	**24400**	**24392**	**24423**
Percentage amount of											
Nitrogen found	15.48	15.44	15.36	15.16	15.24	15.00	15.28	15.44	15.34	15.42	15.36
Nitrogen guaranteed	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Cost per ton	$50.00	50.00	50.00	50.00	51.00	52.00	53.00	55.00	....	....	....
Nitrogen costs cents per pound	**16.1**	**16.2**	**16.3**	**16.5**	**16.7**	**17.3**	**17.3**	**17.8**	....	....	....

DRIED BLOOD.

24424. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Andrew Ure, Highwood. Contained 10.44 per cent. nitrogen, 9.87 per cent. guaranteed.

24824. Sold by Rogers Mfg. Co., Rockfall. Sampled from stock of James Hyland, Highwood. Contained 13.00 per cent. nitrogen.

COTTON SEED MEAL.

(Analyses on pages 381-386.)

One hundred and fifty-seven samples have been analyzed, representing more than 3100 tons which have cost the buyers nearly $120,000. Most of the meal was used as a fertilizer on tobacco.

Sixty-three of the samples contained notably less nitrogen than was guaranteed. The meal is sold to commission men by a large number of mills at the south, many of them quite small, whose managers do not determine the quality of their output by chemical analysis. Their guaranties, therefore, too often represent little more than a guess. Some mill owners, however, well understand how to adulterate their product with cotton seed hulls, which if ground fine and used in moderate amount, do not sensibly affect the appearance of the meal. The commission merchants who handle this meal do not have it under their inspection and never see the most of it. Hence, without the Station's analysis, the buyer could never be sure of the quality of what he bought under guaranty. Most, if not all, of the meal this year sold in the State was bought under guaranty of a certain percentage of nitrogen from parties who agreed to give a satisfactory rebate for any deficiency in nitrogen. The Connecticut dealer receives this rebate and his customers should and do receive their share of it when they claim it. It is, therefore, the buyer's own fault if he suffers because the meal delivered to him has less than the amount of nitrogen guaranteed to him.

The average cost of cotton seed meal this year has been $37.50 per ton, five dollars more than last year's average.

The average percentage of nitrogen has been 6.79, 0.23 per cent. lower than last year.

The average cost of nitrogen in cotton seed meal has been 24.7 cents per pound, over 4 cents per pound more than has ever been paid before r it.

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Analyses of Cotton Seed Meal, 1910.

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by.	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
24450	Humphreys, Godwin & Co., Memphis, Tenn. Spencer Bros., Suffield, 58484 × 33348	J. Davis, F. W. Brown	7.50	6.5	$37.00	21.9
24469	H. G. & Co., Broad Brook Lumber Co.	E. A. Osborn	7.51	6.5	37.00	21.9
24573	" H. K. Brainard, Thompsonville R. 20586	Mrs. E. Rogers, S. Barron	7.28	6.5	36.50	22.2
24496	" Broad Brook Lumber and Coal Co.	H. W. Mohn	7.38	6.5	37.00	22.3
24581	" " " 12375	Broad Brook Lumber and Coal Co.	7.22	---	36.50	22.4
24515	" H. K. Brainard, R. 17230	H. Russell	6.98	6.5	35.40	22.4
24451	" Spencer Brothers, Suffield, M. P. 15133	C. D. Burbank, W. L. Lovell and others	7.51	6.5	38.00	22.6
24624	" Olds & Whipple, Hartford, 13866	Olds & Whipple	7.05	6.5	36.00	22.6
24625	" " " " 65723	" "	7.02	6.5	36.00	22.7
24540	" " " " 90553	" "	7.20	---	37.00	22.8
24494	" " " " 4413	" "	8.28	7.8	42.00	22.9
24381	" H. K. Brainard, P. 5364	O. E. Pitcher	7.66	7.4	39.25	22.9
24631	" Arthur Sikes, Suffield, B. 3959	E. Perkins, C. S. Fuller and others	6.96	6.5	36.00	22.9
24502	" " " " 24168	H. D. Sikes, J. L. Firtion and others	7.04	6.5	36.50	23.0
24187	" Spencer Bros., Suffield, 43789	Bissell-Graves Co.	6.46	6.5	34.00	23.1
24493	" Olds & Whipple, 8857	O. & W.	8.17	7.5	42.00	23.2
23920	" " " 17361	O. & W.	7.45	7.5	39.00	23.4
24354	" " " 8462	H. W. Alford, H. W. Ellsworth	7.67	7.5	40.00	23.4
24765	" " " 31064	O. & W.	7.45	7.4	39.00	23.4
24274	F. W. Brode & Co., Memphis, Tenn. R. H. Ensign Mill, Simsbury, 36178	H. N. Goddard	7.36	6.5	38.50	23.4
23921	H. G. & Co., Olds & Whipple, 79080	O. & W.	7.42	7.5	39.00	23.5
24188	" Spencer Bros., 85865	Bissell-Graves Co.	6.37	6.5	34.00	23.5
24578	" " " 87347	Spencer Bros.	7.00	---	37.00	23.5
24184	" H. K. Brainard, 130992	Geo. Douglass	6.57	6.5	35.10	23.6

Analyses of Cotton Seed Meal, 1910.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by.	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.*
24302	H. G. & Co., Olds & Whipple, 6603	Conn. Tobacco Corporation	6.80	6.6	$36.25	23.6
23992	" " " 7397	O. & W.	7.32	7.5	39.00	23.6
24295	" " " 11954	Conn. Tobacco Corporation	6.77	6.5	36.25	23.7
24299	" " " 47972	" "	6.78	6.5	36.25	23.7
23918	" " " 37698	O. & W.	7.37	7.5	39.00	23.7
24267	" " " 33579 × 26588	"	8.19	8.1	43.00	23.7
24492	" " " 8300	"	8.00	7.9	42.00	23.7
24189	" Spencer Bros., 18324	Bissell-Graves Co.	6.32	6.5	34.00	23.7
24199	" " " 55458	" "	6.31	6.5	34.00	23.7
24212	" Arthur Sikes, 25049	C. F. Whittemore	6.60	---	35.50	23.8
23919	" Olds & Whipple, 85884	O. & W.	7.32	7.5	39.00	23.8
24294	" " " 16464	Conn. Tobacco Corporation	6.74	6.6	36.25	23.8
24296	" " " 47972	" " "	6.74	6.6	36.25	23.8
24297	" " " 6603	" " "	6.73	6.6	36.25	23.8
24298	" " " 11954	" " "	6.77	6.6	36.25	23.8
24711	" " " 124590	O. & W.	7.34	7.5	39.00	23.8
24388	H. E. Bridges & Co., Memphis, Tenn. Olds & Whipple, 11385	"	6.87	6.5	37.00	23.9
23976	Olds & Whipple, 11603	"	7.31	---	39.00	23.9
24708	H. G. & Co., " " 122776	"	7.30	7.5	39.00	23.9
24710	" " " 70012	"	7.40	7.6	39.50	23.9
24194	" Spencer Bros., 17003	Bissell-Graves Co.	6.25	6.5	34.00	23.9
23975	" Olds & Whipple, 15024	O. & W.	7.27	7.5	39.00	24.0
23986	" " " 508896	"	7.28	7.5	39.00	24.0
24626	" " " 17902	"	6.64	6.5	36.00	24.0
24390	H. E. Bridges & Co., Olds & Whipple, 526901	"	6.82	6.5	37.00	24.1
24764	H. G. & Co., " " 123989	"	7.25	7.5	39.00	24.1
24766	" " " 123604	"	7.25	7.5	39.00	24.1

ANALYSES OF COTTON SEED MEAL, 1910.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
24767	H. G. & Co., Olds & Whipple, 31128 × 74951	O. & W.	7.24	7.5	$39.00	24.1
24280	" " " 47364	"	7.42	7.5	40.00	24.2
24763	" " " 34454	"	7.10	7.3	38.50	24.2
24888	" " " 124345	"	7.22	7.3	39.00	24.2
24308	" Loomis Bros., Granby, 26440	S. Viets, C. Root and others	6.70	6.5	36.50	24.2
24191	" Spencer Bros., 6767	J. Rose, *M. Leahey*	6.73	6.5	36.75	24.2
24487	" " " 132440	G. A. Harman, P. Haley and others	6.99	6.5	38.00	24.2
24598	Planters Oil Co., Albany, Ga. G. B. Robinson, N. Y. C., 59371	Ernest Austin	6.35	6.5	35.00	24.3
24468	H. G. & Co., Broad Brook Lumber and Coal Co., 22609	Broad Brook Lumber and Coal Co.	6.67	---	36.50	24.3
24266	H. G. & Co., Olds & Whipple, 61620 × 27207	O. & W.	7.38	7.5	40.00	24.3
24300	" " " 103964 × 56391	"	7.38	7.5	40.00	24.3
24446	" " " 85823 × 17454	"	7.68	7.9	41.50	24.3
24385	H. E. Bridges & Co., Olds & Whipple, 8415	"	6.78	6.5	37.00	24.3
24856	Am. Cotton Oil Co., N. Y. Spencer Bros., 35399	Bissell-Graves Co.	6.63	6.5	36.50	24.4
24713	H. G. & Co., Olds & Whipple, 122385	O. & W.	7.15	7.5	39.00	24.4
24545	" " " 533603	"	6.75	6.5	37.00	24.4
24447	" " " 83454 × 11594	"	7.66	7.9	41.50	24.4
24448	" " " 83723 × 17659	"	7.67	7.9	41.50	24.4
24206	" " " 180656	"	7.30	7.5	40.00	24.5
24198	" Spencer Bros., 64316	D. Barron	6.72	6.5	37.00	24.5
24190	" " " 15267	A. E. Pascoe, O. T. Cone and others	6.71	6.5	37.00	24.5
24479	" Olds & Whipple, 30008	O. & W.	7.30	7.5	40.00	24.6
24301	" " " 74102	"	7.29	7.5	40.00	24.6
24495	" " " 72939 × 9395	"	7.70	7.9	42.00	24.6
24283	H. E. Bridges & Co., Olds & Whipple, 956	"	6.68	6.5	37.00	24.6
24386	" " " " 26690	"	6.68	6.5	37.00	24.6

Analyses of Cotton Seed Meal, 1910.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by.	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
24449	H. E. Bridges & Co., Olds & Whipple, 14691	O. & W.	6.68	6.5	$37.00	24.6
24268	" " " " 67488	"	6.76	6.5	37.50	24.7
24242	H. G. & Co. " " 69926	"	7.86	8.1	43.00	24.7
24243	" " " 65068	"	7.87	8.1	43.00	24.7
24253	Arthur Sikes, 6171	D. I. King	6.67	---	37.00	24.7
24221	H. G. & Co., Spencer Bros., 515090	C. Michel and M. Leahey	6.60	6.5	36.75	24.7
24210	Arthur Sikes, 36705	W. C. Knox, H. Fuller, H. A. Henshaw	6.32	---	35.50	24.8
24282	H. E. Bridges & Co., Olds & Whipple, 8520	O. & W.	6.62	6.5	37.00	24.8
24391	" " " " 12192	"	6.62	6.5	37.00	24.8
24281	H. G. & Co., " " 58090	"	7.25	7.5	40.00	24.8
24353	" " "	Conn. Tobacco Corporation	6.48	---	36.25	24.8
24491	" " " 105351 x 83655	O. & W.	7.62	7.9	42.00	24.9
24714	" " " 23156	"	6.40	6.5	36.00	24.9
24306	" Spencer Bros., 140916	J. Cain, J. Riddle and others	6.80	6.5	38.00	24.9
24406	Am. Cotton Oil Co., " 24604	W. Sikes and A. Organio	6.79	6.5	38.00	25.0
24203	H. G. & Co., " 45061	G. A. Harmon	6.55	6.5	37.00	25.1
24204	" " 94266	M. Leahey and H. Ude	6.50	6.5	36.75	25.1
24223	" Loomis Bros. Co., 37576	S. F. Holcomb, H. E. Hayden and others	6.55	6.5	37.00	25.1
24254	" " " 7478	F. A. Johnson	6.54	6.5	37.00	25.1
24213	" Olds & Whipple, 97600	O. & W.	7.76	8.1	43.00	25.1
24741	" " " 36863	"	6.35	6.5	36.00	25.1
24214	" " " 48163	"	7.73	8.1	43.00	25.2
24218	" Spencer Bros., 7327	G. A. Harmon, A. H. Bridge and others	6.52	6.5	37.00	25.2
24197	" " 14883	C. C. Bissell	6.48	6.5	36.75	25.2
24252	Am. Cotton Oil Co., " 72333	T. Monahan	6.52	6.2	37.00	25.2
24305	H. G. & Co., " 71282	E. A. Fuller, J. Golin and others	6.73	65	38.00	25.2
24241	" Loomis Bros. Co., 3403	E. C. Hills	6.52	6.5	37.00	25.2

ANALYSES OF COTTON SEED MEAL, 1910.—*Continued.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by.	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
24334	H. G. & Co., G. B. Robinson, 18052	E. N. Austin	6.32	6.5	$36.00	25.2
24742	F. W. Brode & Co., R. H. Ensign, Simsbury	H. N. Goddard	6.55	6.5	37.00	25.2
24453	C. C. Johnson & Co., Memphis, Tenn. S. B. Warner, Windsor	A. E. Holcomb	6.33	6.5	36.00	25.2
24182	S. D. Viets, Springfield, Mass.	E. S. Seymour	6.39	6.5	36.45	25.3
24712	H. G. & Co., Olds & Whipple, 122051	O. & W.	6.29	6.5	36.00	25.3
24580	" Broad Brook L. & C. Co., 5696	Broad Brook L. & C. Co.	6.40	...	36.50	25.3
24577	" Spencer Bros., 7714	J. Welch, J. Sullivan and others	6.50	6.5	37.00	25.3
24264	" Arthur Sikes, 3746	R. H. Loomis, G. B. Parks and others	6.50	6.5	37.00	25.3
24272	F. W. Brode & Co., R. H. Ensign, 81764	H. N. Goddard	6.47	6.5	37.00	25.4
24211	Arthur Sikes, 15193	S. H. Graham and E. Perkins	6.33	...	36.25	25.4
24196	H. G. & Co., Spencer Bros, 48345	J. O. Haskins, E. G. Hastings	6.48	6.5	37.00	25.4
24270	H. E. Bridges & Co., Olds & Whipple, 132406	O. & W.	6.58	6.5	37.50	25.4
24383	H. G. & Co., " " 11070	Conn. Tobacco Corporation	6.34	...	36.25	25.4
24709	" " " 132421	O. & W.	6.25	6.5	36.00	25.5
24384	H. E. Bridges & Co., " " 26164	"	6.46	6.5	37.00	25.5
24193	H. G. & Co., Spencer Bros., 5908	G. A. Peckham	6.05	6.2	35.00	25.5
24273	F. W. Brode & Co., R. H. Ensign, 94128	H. N. Goddard	6.46	6.5	37.00	25.5
24382	H. G. & Co., Loomis Bros. Co., 42272	R. B. Chatfield, W. Phelps and others	6.33	6.5	36.50	25.6
24255	" Olds & Whipple, 22574	O. & W.	6.52	6.5	37.50	25.6
24224	" " " 17762	"	6.60	6.5	38.00	25.7
24761	" " " 81592 × 58149	"	6.20	6.5	36.00	25.7
24743	" Spencer Bros., 48162	E. C. Holdredge	6.21	6.2	36.00	25.7
24192	" " " 34228	E. A. Fuller and H. Ude	6.36	6.5	36.75	25.7
24209	Arthur Sikes, 11916	D. L. Brockett and J. Orr	6.38	...	37.00	25.8
24389	H. E. Bridges & Co., Olds & W., 559576 × 4248	O. & W.	6.38	6.5	37.00	25.8
24269	" " " 14357	"	6.46	6.5	37.50	25.8

ANALYSES OF COTTON SEED MEAL, 1910.—*Concluded.*

Station No.	Dealer, Car No. or Marks.	Purchased, Sampled or Sent by.	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
24186	H. G. & Co., Olds & Whipple, 17684	W. S. Pinney	6.92	7.5	$40.00	25.9
24185	" " " 9734	O. & W.	6.89	7.5	40.00	26.0
24762	" " " 38286	"	6.14	6.5	36.00	26.0
24471		Warner Bros.	6.13	---	36.00	26.0
24222	H. G. & Co., Spencer Bros., 62666	A. Anderson, A. Corbin and others	6.48	6.5	38.00	26.1
24623	American Cotton Oil Co.	Thomas Dempsey	6.48	6.5	38.00	26.1
24387	H. E. Bridges & Co., Olds & Whipple, 94805	O. & W.	6.28	6.5	37.00	26.2
24271	" " " " 133382	"	6.35	6.5	37.50	26.3
24195	H. G. & Co., Spencer Bros., 22470	C. O'Brien, S. J. Colter and others	6.07	6.2	36.00	26.3
24200	" " 34772	H. S. Chapman & Co.	5.88	6.2	35.00	26.3
24250	" " 62666	A. Anderson, J. Riddle and others	6.45	6.5	38.00	26.3
24307	" " 69946	E. A. & H. S. Pomeroy	6.25	6.5	37.00	26.3
24201	" " 2718	H. S. Chapman & Co.	5.84	6.2	35.00	26.4
24205	" " 35511	A. Spencer Co., A. Pomeroy	6.10	6.5	36.50	26.5
24277	" H. K. Brainard, A	H. K. B.	6.20	6.5	37.00	26.5
24408	" Broad Brook L. & C. Co., 13819	B. B. L. & C. Co.	6.10	---	36.50	26.5
24579	" Spencer Bros., 4585	E. Halladay, R. Smith and others	5.98	6.5	36.00	26.7
24183	American Cotton Oil Co., H. K. Brainard, 48026	H. K. B.	6.15	6.5	37.00	26.7
24576	H. G. & Co., Spencer Bros., 26989	W. E. Burbank, W. N. Adams and others	5.96	6.5	36.00	26.8
24220	" " 30123	H. S. Chapman & Co. and others	6.12	6.2	37.00	26.9
24470	Olds & Whipple	Manchester Bros., New Hartford	6.44	---	38.80	26.9
24251	F. W. Brode & Co., S. D. Viets, Springfield	Spencer Bros.	6.10	6.5	37.00	27.0
24405	H. G. & Co., Spencer Bros., 38418	Mrs. W. H. Prout and G. N. Thompson	6.28	6.5	38.00	27.0
24202	" " 6102	H. S. Chapman & Co.	5.68	6.2	35.00	27.2
24284	American Cotton Oil Co., " 30071	T. Devine and G. S. Phelps	5.73	6.2	36.00	27.8
24452	" " " "	J. E. Phelps, T. F. Devine and others	5.70	6.2	36.00	28.0
24219	H. G. & Co., " 17544	H. S. Chapman & Co. and others	5.74	6.2	37.00	28.6

This is in our opinion about the limit for it. Tobacco growers should try other forms of nitrogen to replace cotton seed meal, in whole or in part. There is no question that dry ground fish scrap, for instance, could be substituted for a portion at least of the meal The writer has done it with success. No doubt high grade dried blood could also be used. There is no sound reason for the tradition that tobacco must be raised with vegetable forms of nitrogen only. Whatever form is used, whether animal or vegetable, it must be in fine mechanical condition and quickly available.

We are advised that sample **24183** was bought from Chapin & Co., of Boston, who bought of Fleischmann & Co., of Peekskill, and they in turn from the American Cotton Oil Co., of Memphis, whose tags it bore, with a guaranty of 41 per cent. protein, equivalent to 6.56 per cent. nitrogen. The deficiency in nitrogen was made good to the Connecticut purchaser.

We are also advised that samples **24284** and **24202** sold by H. G. & Co., were bought by them from the American Cotton Oil Co., and came from the Georgia Cotton Oil Mill. They contained much lint and hulls and were of course very inferior. The American Cotton Oil Co., when complaint was made, paid to the dealers and through them to customers who had bought it, a satisfactory rebate and also expenses of the negotiations.

CASTOR POMACE AND CASTOR MEAL.

Castor Pomace, a residue from the manufacture of castor oil and extremely poisonous to stock, which will eat it greedily if they have the chance, is used more or less as a fertilizer for tobacco. The following six samples of ground pomace and castor meal have been examined:

24276. Baker's. Sold by the American Agricultural Chemical Co. Sampled and sent by H. K. Brainard, Thompsonville.

24333. Sold by Olds & Whipple, Hartford. Sampled and sent by E. S. Seymour, Suffield.

24317. Sold by O. & W. and sampled from their stock.

24324. Baker's. Sampled from stock of F. S. Bidwell & Co., Windsor Locks.

24544. Castor Meal. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled and sent by M. L. Gilman, Buckland.

24825. Castor Meal. Sampled from stock of Sanderson F. & C. Co.

ANALYSES.

Station No.	24276	24333	24317	24324	24544	24825
Percentage amounts of						
Nitrogen found	5.34	5.02	4.90	4.65	6.22	6.08
Nitrogen guaranteed	5.0	5.0	5.0	4.2	5.9	6.5
Cost per ton	$25.00	24.00	24.00	24.00	28.50	28.50
Nitrogen costs cents per pound	**21.2**	**21.6**	**22.1**	**23.3**	**21.0**	**21.5**

Castor Pomace also contains about 2.0 per cent. of phosphoric acid and 1.0 per cent. of potash. These are taken into account in computing the cost of nitrogen.

The cost of nitrogen in castor pomace and castor meal ranges from 21.0 to 23.3 cents and averages 21.8 cents per pound, being about 3 cents per pound less than in cotton seed meal.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

ROCK PHOSPHATE.

25044 is a sample of this material which is used for the manufacture of acid phosphate. In its present condition it is but very slowly available to plants, at least on our Connecticut soils, and cannot be used with profit considering the relative prices of this and other phosphatic materials. This sample contains 32.24 per cent. of phosphoric acid, with 1.55 per cent. of iron oxide and alumina.

BONE ASH.

This is a waste product from copper mills. The sample contains 37.66 per cent. of phosphoric acid in a form which is quite inert as a fertilizer.

BASIC SLAG PHOSPHATE, OR THOMAS SLAG.

This material is a by-product of the steel manufacture, containing from 17 to 19 per cent. of phosphoric acid and 45 to 50 per cent. of lime in finely divided form. The lime is in an efficient form for correcting acidity of the soil. The phosphoric acid is fairly available to plants, though showing small "availa-

bility" by the conventional method which is discussed on page 35 of this report. In most cases it will probably be found less quick in its action as a source of phosphoric acid, but more lasting in its effects than acid phosphate.

For top-dressing grass land and for fruit trees it has given very satisfactory results.

All the samples were imported and sold by the Coe-Mortimer Co., of New York.

24248. Sampled and sent by C. L. Gold, West Cornwall.

24292. Sampled and sent by J. F. Shepard, New Haven.

24311. Sampled from stock of Apothecaries Hall Co., Waterbury.

The analysis shows something less than the guaranteed amount and less than the German analysis of the cargo which was represented by our sample. As the goods had been distributed, our agent was unable to draw a second sample of the stock.

24501. Sampled and sent by Thos. Griswold & Sons, Wethersfield.

All these samples are guaranteed to contain from 17 to 19 per cent. of phosphoric acid, of which 15 to 16 per cent. is "available" by Wagner's method of extraction, with 35 to 50 per cent. of lime.

ANALYSES OF THOMAS SLAG.

Station No.	24248	24292	24311	24501
Percentage amounts of				
Phosphoric acid	18.83	17.76	16.95	18.54
Price per ton		$20.00	18.00	19.00

DOMESTIC SLAG.

24207. Sent by T. W. Head, Groton, is stated to be from American Steel Works, not offered for sale in Connecticut, but sent to learn whether it was worth purchasing.

It contained:

Silica and sand	28.94
Oxide of iron and alumina	20.63
Lime	37.77
Magnesia	7.72
Phosphoric acid	4.94
	100.00

Obviously, this material cannot be brought to Connecticut and used to any profit as a fertilizer.

PRECIPITATED BONE PHOSPHATE.

24427. This is a manufacturing waste, bought of Olds & Whipple, Hartford, for experiment. It is a fine white powder, containing phosphoric acid, mostly insoluble in water, but apparently very readily available to plants. It is an excellent form for use as a tobacco fertilizer. It contains:

Water-soluble phosphoric acid	1.72	per cent.
Citrate-soluble phosphoric acid	35.26	
Citrate-insoluble phosphoric acid	4.62	
Total	41.60	

DOUBLE SUPERPHOSPHATE.

24448. Bought by the Station for experiment of Olds & Whipple, Hartford. This is not sold at retail, but is mostly used in the manufacture of mixed fertilizers of high grade. It contains:

Water-soluble phosphoric acid	41.38	per cent.
Citrate-soluble phosphoric acid	2.88	
Citrate-insoluble phosphoric acid	0.90	
Total	45.16	

DISSOLVED ROCK PHOSPHATE OR ACID ROCK AND DISSOLVED BONE BLACK.

(Analyses on page 391.)

These materials are made by treating various mineral phosphates, spent bone black, or bone with oil of vitriol.

24226. Sold by Berkshire Fertilizer Co., Bridgeport. Sampled from stock of T. W. Ryan, Stratford.

24520. Sold by Bowker Fertilizer Co., New York City. Sampled and sent by S. L. Tuttle, Wallingford.

24484. Sold by Atlantic Fertilizer Co., Baltimore. Sampled from stock bought by L. Harkavy, Sec'y, Leonard's Bridge.

24239. Sold by American Agricultural Chemical Co., New York. Sampled from stock of S. D. Woodruff & Sons, Orange.

24622. Sold by National Fertilizer Co., New York. Sampled acid sent by A. E. Potwine, E. Windsor.

ANALYSES OF ACID PHOSPHATE.

Station No.	24226	24520	24484	24239	24622	24660	24430	24358
Percentage amount of								
Water-soluble phosphoric acid	13.66	11.92	10.56	12.04	12.78	13.64	12.60	14.54
Citrate-soluble phosphoric acid	2.70	2.43	4.05	2.85	2.61	1.85	2.10	1.83
Citrate-insoluble phosphoric acid	0.19	1.94	1.89	0.87	2.48	0.64	3.73	0.12
Total phosphoric acid	16.55	16.29	16.50	15.76	17.87	16.13	18.43	16.49
Sum of water-soluble and citrate-soluble phosphoric acid found	16.36	14.35	14.61	14.89	15.39	15.49	14.70	16.37
"Available" phosphoric acid guaranteed	16.0	----	14.0	14.0	----	14.0	----	----
Cost per ton	$15.00	13.00	13.85	15.00	15.50	15.50	17.50	17.00
"Available" phosphoric acid costs cents per pound	**4.5**	**4.5**	**4.7**	**5.0**	**5.0**	**5.0**	**5.1**	**5.2**

Station No.	24327	24662	24402	24395	24289	24425	24813	----
Percentage amount of								
Water-soluble phosphoric acid	11.11	11.60	13.68	12.08	11.35	11.62	10.19	----
Citrate-soluble phosphoric acid	3.52	4.32	0.99	2.88	3.07	3.24	7.09	----
Citrate-insoluble phosphoric acid	1.55	2.17	0.13	0.74	1.69	1.04	1.01	----
Total phosphoric acid	16.18	18.09	14.80	15.70	16.11	15.90	18.29	----
Sum of water-soluble and citrate-soluble phosphoric acid found	14.63	15.92	14.67	14.96	14.42	14.86	17.28	----
"Available" phosphoric acid guaranteed	----	----	14.0	14.0	----	14.0	----	----
Cost per ton	$15.50	17.00	----	----	----	----	----	----
"Available" phosphoric acid costs cents per pound	**5.3**	**5.3**	----	----	----	----	----	---

24660. Sold by Nitrate Agencies Co., New York. Sampled from stock of John Merrill, Suffield.

24430. Sold by E. D. Chittenden Co., Bridgeport. Sampled from stock of D. L. Clark, Milford.

24358. Sold by Wilcox Fertilizer Co., Mystic. Sampled at the factory.

24327. Sold by Bowker Fertilizer Co. Sampled from stock of W. B. Rice, Meriden.

24662. Sold by Rogers Mfg. Co., Rockfall. Sampled from their stock.

24402. Sold by Patrons Exchange, Danielson. Sampled and sent by C. R. Treat, Orange.

24395. Sold by American Agricultural Chemical Co. Sampled from stock bought by Connecticut School for Boys, Meriden.

24289. Sold by Bowker Fertilizer Co. Sampled and sent by John Gotta, Portland.

24425. Sold by American Agricultural Chemical Co. Sampled from stock bought by Andrew Ure, Highwood.

24813. Sold by Rogers Mfg. Co. Sampled from stock of James Hyland, Highwood.

COST AND VALUATION.

The retail cash cost of acid phosphate has ranged from $13.00 to $17.50 per ton and averaged $15.50, making "available" phosphoric acid cost 4.96 cents per pound. In mixed car lots "available" phosphoric acid has been bought by farmers for 4 cents per pound.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH-GRADE SULPHATE OF POTASH.

(Analyses on page 394.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), equivalent to about 49 per cent. of potassium oxide ("potash"), and it should be nearly free from chlorides. The seven samples analyzed were of good quality, with exception of **24314**, which showed less potash than was guaranteed. A second sample, **24497**, drawn from the same place had a percentage of potash well above what was guaranteed.

The average cost of potash in high grade sulphate has been a little ss than 5 cents a pound.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

(Analyses on page 394.)

This material is usually sold as "sulphate of potash" or "manure salt," on a guaranty of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, and varying quantities of moisture.

The single sample analyzed was of average composition.

The cost of potash per pound in double sulphate of potash is usually somewhat higher than in high grade sulphate.

MURIATE OF POTASH.

(Analyses on pages 394 and 395.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), equivalent to 50.5 per cent. of actual potash, 15 per cent. or more of common salt (sodium chloride) and 4 per cent. or more of water.

Most of the sixteen samples examined were of standard quality.

24499 was drawn from 5 bags and is much below the average composition. Two other samples, **24348** and **24290** from the same firm, show 49.68 and 54.06 per cent. of potash, respectively.

The price per pound of actual potash in the muriate has ranged from 3.8 to 4.8 cents, the average being 4.25 cents.

KAINIT.

(Analyses on page 395.)

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It usually contains more water than either the sulphate or the muriate of potash and is sold on a guaranty of 12 to 15 per cent. of potash.

A sample, **24658**, drawn from stock bought by August Grulich, Meriden, and taken from a single bag, marked "Kainit," was found to contain 46.21 per cent. of potash, chiefly in form of sul-

Potash Salts. Percentage Composition and Cost Per Pound of Potash.

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	*Cost per ton.*	Potash costs *cents per* pound.
	High Grade Sulphate of Potash.					
24661	John Merrill, Suffield, from Nitrate Agencies Co., N. Y.	Station Agent	50.47	....	$46.00	4.6
24497	Apothecaries Hall Co., Waterbury, from German Kali Works, Baltimore	Station Agent	49.60	48.0	48.00	4.8
24663	Rogers Mfg. Co., Rockfall	Station Agent	49.46	48.0	48.00	4.9
24314	Apothecaries Hall Co., from German Kali Works.	Station Agent	47.56	48.0	48.00	5.0
24357	Wilcox Fertilizer Co., Mystic	Station Agent	48.35	48.0	52.00	5.4
23981	A. A. Young, Jewett City, from C. M. Shay Fertilizer Co., Groton	A. A. Young	49.00	....	....	....
24432	D. L. Clark, Milford, from Am'n Agric. Chem. Co., N. Y.	Station Agent	50.52	48.0	....	....
	Low Grade Sulphate of Potash.					
24397	Conn. School for Boys, Meriden, from A. A. C. Co., N. Y.	Station Agent	26.59	26.0	....	....
	Muriate of Potash.					
24517	S. L. Tuttle, from Bowker Fertilizer Co., N. Y.	S. L. Tuttle	50.05	49.0	38.00	3.8
24319	Sanderson Fert. & Chem. Co., New Haven.	Station Agent	55.16	50.0	43.00	3.9
24499	Thos. Griswold & Co., S. Wethersfield, from Coe-Mortimer Co., N. Y.	T. Griswold & Co.	47.51	48.0	39.00	4.1
24227	T. W. Ryan, Stratford, from Berkshire Fert. Co., Bridgeport	Station Agent	48.80	50.5	40.00	4.1
24325	Wm. B. Rice, Meriden, from Bowker Fert. Co.	Station Agent	49.40	49.0	40.50	4.1
24665	Rogers Mfg. Co., Rockfall	Station Agent	50.27	48.0	.42.00	4.2
24313	F. S. Platt Co., New Haven	Station Agent	51.68	50.0	43.50	4.2

POTASH SALTS. PERCENTAGE COMPOSITION AND COST PER POUND OF POTASH.—*Continued.*

Station No.	Drawn from Stock in possession of	Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton.	Potash costs cents per pound.
	Muriate of Potash, continued.					
24431	D. L. Clark, Milford, from A. A. C. Co.	Station Agent	52.89	49.0	$45.00	4.3
24348	R. H. Morgan, Cheshire, from Coe-Mortimer Co.	Station Agent	54.06	50.0	48.00	4.4
24290	J. F. Shepard, *New Haven, from Coe-Mortimer* Co.	J. F. Shepard	49.68	48.0	44.40	4.5
24356	Wilcox Fert. Co., Mystic.	Station Agent	48.28	48.0	44.00	4.6
24322	F. S. Bidwell & Co., Windsor Locks, from A. A. C. Co.	Station Agent	52.40	49.0	50.00	4.8
24238	S. D. Woodruff & Sons, from Nitrate Agencies Co.	Station Agent	51.04	50.0	....	....
24287	John Gotta, Portland, from Bowker Fert. Co.	J. Gotta	50.24	49.0	....	....
24394	Conn. School for Boys, Meriden, from A. A. C. Co.	Station Agent	53.45	49.0	....	....
24403	C. R. Treat, Orange.	Station Agent	51.92	49.0	....	....
	Kainit.					
24323	A. D. Bridge's Sons, Hazardville, from A. A. C. Co.	Station Agent	13.32	12.0	14.00	5.3
24393	Conn. School for Boys, Meriden, from A. A. C. Co.	Station Agent	11.75	12.0	....	....

phate. It was apparently sweepings, probably shipped by mistake and contained nearly four times as much potash as kainit, for which it was sold.

VEGETABLE POTASH.

This material, sold by Olds & Whipple, Hartford, is understood to be the ashes of beet residues from the beet sugar manufacture, and is considerably used as a source of potash in tobacco formulas. The single sample examined, **24667**, contained:

Percentage amounts of	
Potash calculated as muriate	1.20
" " " sulphate	1.55
" " " carbonate	23.17
Total water-soluble potash	25.92
Potash costs cents per pound	**8.5**

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

(ANALYSES ON PAGES 398 AND 399.)

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of *crushing fresh or moist bones which have been cooked in steam* tanks to recover grease, and are sometimes sold as "tankage"; or they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are equally fine, the nitrogen of all these varieties of bone probably has about the same fertilizing value. But agricultural value of bone depends very largely on its fineness. It is a matter of common observation that a whole bone may lie in the ground for a good while without going to pieces. Fine grinding increases enormously the surface which plant roots and the disintegrating forces of the soil can act upon and by so doing make the nitrogen and phosphoric acid available. Much of the bone now sold is dry and could be easily ground finer than it usually is, and more attention should be paid, both by manufacturers and purchasers, to the fineness of this material. Increased demand for a fine bone dust will soon make it more common in the market.

The table of analyses of bone manures contains a column headed "Valuation per ton."

Full explanation of the meaning of this term, and the method of calculating the "valuation" of fertilizers, is given on pages 40 to 44 of this report and need not here be repeated. The "trade values" used in 1910, however, differ somewhat from those given on page 41 which apply to the previous year. The schedule of trade values in force in 1910 is as follows:

	Cents per pound.
Nitrogen in nitrates	16
ammonia salts	16
Organic nitrogen in dry and fine ground fish, meat and blood, and in mixed fertilizers	20
in fine† bone and tankage	20
in coarse† bone and tankage	15
Phosphoric acid, water-soluble	4½
citrate-soluble‡	4
of fine ground bone and tankage	4
of coarse bone and tankage	3½
of cotton seed meal, castor pomace and ashes	3½
of mixed fertilizers, if insoluble in ammonium citrate‡	2
Potash as high-grade sulphate in forms free from muriate (or chlorides)	5
as muriate	4¼

1. *Bone Manures Sampled by the Station Agent.*

In the tables on pages 398 and 399 are tabulated analyses of twenty-two samples.

GUARANTIES.

Of the samples having a guaranty, six failed in one particular to meet it but the deficiency was met by a corresponding excess of the other ingredient in most cases, so that a full money equivalent was given for the plant food guaranteed.

24842. Rogers & Hubbard's Strictly Pure Fine Bone was found to contain 19.45 per cent. of phosphoric acid. This is

† In this report "fine," as applied to bone and tankage, signifies smaller than $\frac{1}{50}$ inch; and "coarse," larger than $\frac{1}{50}$ inch.

‡ Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" phosphoric acid.

Station No.	Manufacturer and Name or Brand.	Dealer or Purchaser.
	BONE MANURES.	
	Sampled by Station Agent:	
24829	Amer. Agric. Chem. Co., Fine Ground Bone	J. A. Glassnapp; D. L. Cla
24830	Amer. Agric. Chem. Co., Bone Meal	R. H. Hall, East Hampton
24831	Armour Fertilizer Co., Bone Meal	E. A. Buck & Co., Willim
24483	*Atlantic Fertilizer Co., Ground Bone*	L. Harkavy, * Leonard's B
24228	Berkshire Fertilizer Co., Fine Ground Bone	T. W. Ryan, Stratford
24832	Bohl, Valentine, Self Recommending Fertilizer	Valentine Bohl
24833	Bowker Fert. Co., Bowker's Fresh Ground Bone	Lightbourn & Pond; W. B. N
24834	Buffalo Fertilizer Co., Bone Meal	L. A. Fenton, Norwich To
24835	Dennis, G. L., Ground Bone	Manufacturer
24836	Frisbie Co., The L. T., Frisbie's Fine Bone Meal	"
24837	Lister Fert. & Chem. W'ks, Lister's Ground Bone	J. A. Foster, Stafford Spri
24838	National Fert. Co., Chittenden's Ground Bone	H. A. Bugbee, Willimanti
24839	*New England Fertilizer Co., Ground Bone*	*H. S. Pomeroy, Suffield*
24840	Niantic Menhaden Oil & Guano Co., Ground Bone	W. C. Reynolds, E. Hadd
24841	Rogers & Hubbard Co., Hubbard's Raw Knuckle Bone Flour	H. W. Andrews, Wallingf
24842	Rogers & Hubbard Co., Hubbard's Strictly Pure Fine Bone	F. S. Platt Co., New Have
24843	Rogers Mfg. Co., Knuckle Bone Flour	Arthur Sikes; W. C. Bulk
24844	Rogers Mfg. Co., Ground Bone	G. W. Eaton, Bristol
24845	C. M. Shay Fert. Co., Ground Bone	G. M. Williams Co., N. L
24846	*Shoemaker & Co., M. L., Swift-Sure Pure Bone Meal*	*Olds & Whipple, Hartford*
24847	Swift's Lowell Fertilizer Co., Swift's Lowell Ground Bone	H. W. Andrews; F. S. Bidwel
24848	Wilcox Fert. Co., Wilcox's Pure Ground Bone	Gallagher Bros., Wallingf
	Sampled by Purchasers and others:	
24232	Bowker Fertilizer Co., Bone Meal	W. R. Pierson, Cromwell
24519	Bowker Fertilizer Co., Fresh Ground Bone	S. L. Tuttle, Wallingford
25199	Cooper's Glue Factory, Peter, Pure Bone Meal	Fred Lyman, Manchester
23994	Eastern Chem. Co., Boston, Bone Flour	A. A. Young, Jewett City
24572	L. T. Frisbie Co., New Haven, Ground Bone	P. M. Pommeau, Simsbur
24849	E. L. James, Warrenville, Ground Bone	Sent by Manufacturer
23980	C. S. Page, Hyde Park, Vt., Pure Raw Ground Bone	A. A. Young, Jewett City
24256	Rogers Mfg. Co., Bone Meal	A. N. Pierson, Cromwell
24571	Sanderson Fertilizer & Chemical Co., Bone Meal	Noble Bros., Simsbury
25098	C. M. Shay Fert. Co., Bone Meal	T. W. Head, Groton
	TANKAGES.	
	Sampled by Station Agent:	
24236	American Agric. Chem. Co., N. Y.	S. D. Woodruff & Sons, C
24396	" " " " "	Conn. School for Boys, M
24422	" " " " "	Andrew Ure, Highwood
24433	" " " " "	D. L. Clark, Milford
24312	Conn. Fat Rendering & Fert. Corp., New Haven	Manufacturer
24822	Frisbie Co., The L. T., New Haven	"
666	Rogers Manufacturing Co., Rockfall	"
3	" " " "	James Hyland, Highwood
	From Chicago	C. R. Treat, Orange
	Sampled by Purchasers and others:	
	r Fertilizer Co., N. Y.	*John Gotta, Portland*
	" " "	S. L. Tuttle, Wallingford
	Fertilizer Co., Buffalo, N. Y.	Tanner & Wilcox, Winsted

Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen. Found.	Chemical Analysis. Nitrogen. Guaranteed.	Chemical Analysis. Phosphoric Acid. Found.	Chemical Analysis. Phosphoric Acid. Guaranteed.	Mechanical Anal[ysis] Finer than 1-50 inch.	Coarser than
$33.00	$27.18	21.4	2.64	2.5	23.52	22.0	56	[illegible]
26.00	19.97	30.2	2.15	1.6	16.02	13.7	61	[illegible]
34.00	29.08	16.9	1.86	2.0	28.96	24.0	68	[illegible]
29.80	28.02	6.4	1.98	--------	28.38	--------	46	[illegible]
28.00	27.12	3.2	3.38	3.3	22.02	17.0	28	[illegible]
28.00	32.04	†12.6	4.06	3.8	22.00	23.0	71	[illegible]
32.50	27.66	17.5	2.70	2.5	23.48	22.9	62	[illegible]
29.00	26.84	8.0	2.40	2.9	24.10	22.0	57	[illegible]
30.00	27.44	9.3	2.75	3.0	24.86	20.0	34	[illegible]
30.00	31.39	† 4.4	4.05	3.3	22.28	18.0	58	[illegible]
32.00	19.18	66.8	3.08	2.7	11.59	12.0	43	[illegible]
30.00	20.43	46.8	1.93	1.7	18.06	13.8	53	[illegible]
31.00	27.93	11.0	2.52	2.5	24.97	23.0	57	[illegible]
33.00	25.72	28.3	2.81	2.5	20.52	20.6	60	[illegible]
37.00	32.02	15.6	3.85	3.5	24.72	24.5	50	[illegible]
35.00	26.41	32.5	3.70	2.9	19.45	22.0	30	[illegible]
35.50	33.83	4.9	3.85	3.3	25.94	24.0	64	[illegible]
32.00	33.42	† 4.2	3.44	2.5	26.28	22.0	77	[illegible]
35.00	29.79	17.5	2.60	1.7	27.20	22.9	55	[illegible]
37.00	37.67	† 1.8	5.38	4.5	23.74	20.0	63	[illegible]
31.00	30.45	1.8	3.07	2.5	26.58	23.0	46	[illegible]
32.00	27.57	1.7	2.72	2.4	24.38	22.0	45	[illegible]
24.00	27.39	†12.4	2.48	2.5	25.92	22.3	35	[illegible]
29.00	27.77	4.4	2.35	2.47	24.76	22.88	70	[illegible]
27.40	28.67	† 4.4	2.25	2.1	27.06	22.5	60	[illegible]
28.50	--------	--------	2.00	--------	--------	--------	--------	---
30.00	31.15	† 3.7	3.30	3.3	25.36	18.0	60	[illegible]
30.00	26.69	12.4	3.90	3.0	20.95	20.0	5	[illegible]
35.00	29.57	18.4	3.90	4.5	23.74	22.5	20	[illegible]
25.00	28.25	†11.5	0.72	--------	31.82	--------	97	
28.00	26.13	7.2	3.43	--------	20.64	--------	25	[illegible]
32.00	--------	--------	2.29	--------	27.10	--------	--------	---
36.00	33.05	8.9	7.55	7.6	9.39	--------	45	[illegible]
--------	28.07	--------	5.84	5.8	10.72	10.0	44	[illegible]
--------	28.90	--------	5.04	4.9	15.26	13.7	47	[illegible]
--------	29.32	--------	5.48	4.9	13.52	13.7	50	
25.00	31.72	†21.2	5.60	6.2	16.98	16.5	42	
30.00	26.39	13.7	3.60	4.9	18.38	15.0	50	
35.00	31.94	9.6	6.45	6.6	13.10	10.5	44	[illegible]
--------	35.34	--------	6.66	--------	14.40	--------	65	[illegible]
--------	25.02	--------	5.87	--------	6.92	--------	39	[illegible]
--------	28.73	--------	4.74	4.9	15.52	13.8	58	[illegible]
28.00	28.26	† 0.9	5.35	4.9	12.43	13.7	53	[illegible]
30.00	30.92	† 3.0	6.04	6.1	12.65	9.16	54	[illegible]
30.00	27.49	9.1	4.12	4.7	17.27	15.0	52	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

much less than has been found in this brand in other years, and the manufacturers claim does not represent the average quality of the goods.

COST AND VALUATION.

The average cost per ton of the 22 brands examined was $31.85 and the valuation $28.25. The average cost is half a dollar greater than last year and the average valuation nearly three dollars more.

2. Sampled by Others than the Station Agent.

In the tables on pages 398 and 399 are included ten analyses of samples drawn by others than the Station Agent. The Station is responsible only for the analyses: not for the correctness of the sampling of these.

SLAUGHTER-HOUSE TANKAGE.

(ANALYSES ON PAGES 398 AND 399.)

After boiling or steaming various slaughter-house wastes, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. In general, it contains more nitrogen and less phosphoric acid than bone.

1. Slaughter-House Tankage Sampled by the Station Agent.

In the table following the bone manures are analyses of nine samples of this material from the Connecticut market.

Tankage has a very wide range of composition, some sorts being quite like bone. This year ground tankage has been on the whole more finely pulverized than bone.

The finer the fertilizer, up to a certain point, the more even will be its distribution in the soil and the quicker will crops get hold of it. There is room for considerable improvement in the mechanical condition of both bone and tankage. Five of the samples had no statement of cost with them. Some were bought in car lots and, therefore, at considerably less than retail market prices, and some no doubt with special discounts which would be of no general interest or value.

2. Sampled by Others than the Station Agent.

The table includes analyses of five samples drawn by others than the Station Agent.

DRY GROUND FISH AND ACIDULATED FISH.

(Analyses on page 402.)

This is a by-product from the manufacture of fish oil, a process which removes from the fish little that is of value as a fertilizer.

The fresh fish are cooked by steam, pressed to remove the oil, and dried either in the air or by steam. The scrap is sometimes sprinkled with diluted oil of vitriol, to check putrefaction, whereby the bones are softened and to some extent dissolved. Nineteen samples have been examined, eighteen of which are described in the table. Samples **24814**, **24233**, **24234** and **24235**, stated to be made by the Wilcox Fertilizer Co., but sold by the Rogers Mfg. Co. to the persons named, have the composition of Wilcox's Dry Ground Acidulated Fish Scrap, which has a guaranty of 7.81 per cent. nitrogen, rather than of their Dry Ground Fish Guano, in which 8.50 per cent. of nitrogen is guaranteed. The tags attached to the goods, however, gave 10 per cent. ammonia as the guaranty. This is equivalent to 8.26 per cent. nitrogen and is not the amount guaranteed in either of the Wilcox brands. In samples drawn by the Station Agent, from two lots of Mr. Graves' purchase, **24455** and **24456**, were found 8.00 and 8.19 per cent. of nitrogen. The manufacturers protested that the analyses of sample **24359** did not represent the average composition of this brand and requested that another sample be drawn elsewhere in this State. This was done and, by its analysis, **24816** shows considerably more nitrogen than was found in the other sample.

Cost and Valuation.

The seven samples known to be dry ground fish, which were sampled by the Station, have on an average 8.5 per cent. of nitrogen and 8.0 per cent. of phosphoric acid. The average valuation is within one dollar of the average cost.

The six samples of acidulated fish have, on an average, 7.70 per cent. of nitrogen and 5.1 per cent. of phosphoric acid.

ERCENTAGE COMPOSITION AND VALUATION OF DRY GROUND FISH AND ACIDULATED DRY FISH.

	Manufacturer or Dealer.	Nitrogen.		Phosphoric acid.			Total phosphoric acid.		Cost per ton.	Valuation per ton	Percentage difference between cost and valuation.
		Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.			
	DRY GROUND FISH.										
	Sampled by Station Agent:										
7	American A. C. Co. Sampled in Suffield, Glastonbury and Granby	8.12	8.2	0.96	4.62	1.24	6.82	-----	$40.00	$37.22	7.5
5	Berkshire Fertilizer Co. Stock of T. W. Ryan, Stratford	9.33	8.0	0.62	5.35	0.93	6.90	9.0	40.00	42.53	5.9*
9	Bowker Fertilizer Co. Stock of W. S. Morris, Wethersfield	8.32	8.0	0.82	7.23	0.87	8.92	-----	40.00	39.77	0.6
8	Essex Fertilizer Co. Stock of Spencer Bros., Suffield	8.30	7.5	0.47	9.59	3.94	14.00	-----	42.00	42.77	1.8*
6	National Fertilizer Co. Stock of G. A. Williams, Silver Lane	8.64	8.2	0.84	4.62	1.52	6.98	-----	40.00	39.21	2.2
6	Olds & Whipple, Hartford. Stock of O. & W.	8.06	8.2	0.75	5.20	0.55	6.50	-----	40.00	36.24	10.4
5	Sanderson Fert. Chem. Co. Sampled at Glastonbury and factory	7.94	8.2	2.07	3.40	0.33	5.80	6.0	40.00	35.80	11.7
9	Wilcox Fertilizer Co., by Rogers Mfg. Co. Stock of Arthur Sikes, Suffield	8.20	7.8	2.10	4.30	0.41	6.81	-----	40.00	37.22	7.4
0	Wilcox Fertilizer Co. Stock of Spencer Bros., Suffield	8.82	8.5	0.59	4.12	1.11	5.82	-----	42.00	39.43	6.5
4	Wilcox Fertilizer Co., by Rogers Mfg. Co. Stock of L. J. Grant, Wapping	7.59	7.8	1.91	3.71	0.38	6.00	5.0	40.00	34.66	15.4
	Sampled by Purchasers and others:										
0	Bowker Fertilizer Co. Sampled by I. B. Barnard, Bloomfield	8.13	8.2	0.87	6.69	0.86	8.42	-----	40.00	38.64	3.5
3	Wilcox Fertilizer Co., by Rogers Mfg. Co. Sampled by A. N. Graves, Windsor Locks	8.08	8.2	2.10	3.45	0.27	5.82	5.0	37.00	37.08	0.2*
4	Wilcox Fertilizer Co., by Rogers Mfg. Co. Sampled by A. N. Graves, Windsor Locks	7.79	8.2	2.05	3.75	0.19	5.99	5.0	37.00	36.09	2.5
5	Wilcox Fertilizer Co., by Rogers Mfg. Co. Sampled by A. N. Graves, Windsor Locks	7.68	8.2	2.08	3.29	0.26	5.63	5.0	37.00	35.32	4.7
1	Dealer unknown. Sampled by Michael Donovan, South Windsor	8.44	-----	1.05	6.74	0.59	8.38	-----	38.00	39.59	4.0*
	ACIDULATED DRY FISH.										
9	Niantic Menhaden Oil & Guano Co. Sampled in East Haddam and Moodus	5.80	3.3	0.22	3.80	3.50	7.52	3.5	27.00	27.12	0.5*
9	Wilcox Fertilizer Co. Sampled by Station Agent at factory	7.75	7.8	1.94	3.62	0.30	5.86	5.0	36.50	35.24	3.6
9	[illegible] Sampled by Station Agent	8.03	8.2	2.17	3.05	0.29	6.41	5.0	37.00	36.23	2.1

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

(ANALYSES ON PAGES 406 TO 426.)

Here are included all the commercial mixed fertilizers containing nitrogen, phosphoric acid and potash which have been analyzed in 1910.

We have abandoned the previous practice of tabulating by themselves those mixed fertilizers which were advertised as specially adapted to some special crop, because there were no differences of composition or ingredients distinctive enough to warrant such a separation. The "potato manures," for instance, put out by different manufacturers differ from each other in composition almost as much as the potato manures differ from the corn or market garden manures.

Other changes in the method of tabulation will be noticed. The fertilizer analyses, for instance, are arranged alphabetically, according to the manufacturers' names, so that the analyses of all the brands of each firm appear together. The names of the towns where the samples were drawn are given, but not the names of the particular persons whose stock was sampled. A report of the analysis has been made to each person whose stock was examined, but it does not seem essential to publish all these names in this report.

These various changes are made necessary by the restrictions on the Station printing. The number of pages allowed by the State Board of Control makes it necessary to condense everything into the least possible space. No doubt some will miss the arrangement of the fertilizers in the order of the percentage differences between cost and valuation. These percentage differences are all given in the table and in the case of different fertilizers can readily be compared.

1. *Samples Drawn by the Station Agent.*

In the table pages 406 to 426 are given analyses of two hundred and sixty-four samples. Several of them require explanation or special notice.

Samples Requiring Special Notice.

The American Agricultural Chemical Co.'s Complete Tobacco Manure is of two kinds, the one containing potash as sulphate,

and the other as carbonate. **24794**, p. 406, is obviously the former and **24696** the latter kind.

It will be noticed that, in this and other tobacco fertilizers claimed to contain potash in form of carbonate, our analyses show more or less of the potash calculated as sulphate and muriate. In many cases a chemical analysis cannot certainly prove or disprove the statement that potash is present in form of carbonate.

In making valuations for these fertilizers, potash sufficient to combine with the chlorine present is calculated as chloride; potash sufficient to combine with all the sulphuric acid present is calculated as sulphate, and any excess of potash remaining is then calculated as carbonate. We repeat that this does not necessarily conflict with the manufacturer's statement that a part or all of the potash was put into the mixture as high-grade carbonate. The matter has been fully discussed in previous reports.

The American Agricultural Chemical Co. requested that a second sample of their Grass and Lawn Top Dressing be analyzed as **24367** had less nitrogen than was guaranteed, and did not in their opinion represent the general quality of this brand. A second sample, **24533**, had about the same percentage of nitrogen as the other, and a third, **24547**, had the guaranteed amount.

The American Agricultural Chemical Co. made a similar request regarding sample **24634**, p. 408, Great Eastern Northern Corn Special, which contained half a per cent. less nitrogen than was guaranteed. A second sample drawn by our agent from different stock, **24850**, fully met the guaranty.

The above company also asked for a second sample and analysis of their Packer's Union Gardeners' Complete, analysis **24605**, p. 408, having shown a deficiency of about one per cent. of potash. The second sample, **24851**, fully met the guaranty of potash, but was below it in nitrogen.

A similar request was made regarding Wheeler's Havana Tobacco Grower, **24697**, p. 408, the analysis of which showed a deficiency of three-quarters of one per cent. of potash. The second analysis, **24886**, met the guaranty in all respects.

Bowker's Tobacco Ash Elements, **24699**, p. 412, represents a mixture of the three samples drawn respectively from stocks of Seth Viets, West Suffield, W. H. Prout, Suffield, and C. F. Brewer, Silver Lane. The analysis shows 2.8 per cent. more of "available" phosphoric acid and 1.3 per cent. less of potash than

was guaranteed. Separate tests for potash in the three samples gave 13.43, 11.34 and 16.76 per cent. and showed that the three samples were quite unlike in composition. Another sample of the same brand, drawn from the stock of A. D. Bridge's Sons, Hazardville, **25050**, contained 12.91 per cent. of potash, a deficiency of 2.1 per cent. but an overrun of 5 per cent. of "available" phosphoric acid.

Coe-Mortimer Co. protested that analysis **24700** of their Tobacco and Onion Fertilizer (p. 414), which showed a deficiency of about one per cent. of potash, did not represent the quality of this brand. The company submitted affidavits from their factory superintendent, giving the formulas by which the fertilizer had been made and which gave a calculated composition quite different from the Station analysis. The two compare as follows:

	Calculated from Formula.	Station Analysis.	Guaranteed by Manufacturer.
Nitrogen	3.34	3.68	3.0
Total phosphoric acid	6.05	7.96	7.0
Potash	8.00	6.94	8.0

It was not possible to find another sample of this brand on sale after receiving the above protest and making a second analysis. The analysis shows that the overrun in nitrogen and phosphoric acid was more than equivalent in money value to the deficiency in potash.

It is quite possible that in bagging and transit the work of mixing was partially undone and that in the samples taken there was in consequence an undue proportion of the things which contained nitrogen and phosphoric acid (tankage for instance) and a deficiency of potash salts.

Lister's Agricultural Chemical Works advise that in their Complete Tobacco Manure, **24702**, p. 416, carbonate is the only form of potash used, while in the analysis it is all calculated as muriate or sulphate. There is no reason to doubt this statement. Enough sulphuric acid and chlorine were present, however, to combine with all the potash, and carbonate is only used rationally in tobacco manures to avoid the introduction of these acids. See the remarks above, under American Agricultural Chemical Co.'s Tobacco Manure.

The National Fertilizer Co., noting the deficiency of potash in **24789**, p. 418, their Tobacco Special with Carbonate of Potash

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash
	Sampled by Station Agent:		
	The American Agricultural Chemical Co., New York City.		
24504	Complete Manure with 10% Potash	Milford, Wilton, Plainville	$3
24645	Complete Tobacco Manure (from Sulphate)	Windsor Locks, So. Manchester, Glastonbury	3
24794	*Complete Tobacco Manure (from Sulphate)	So. Manchester	3
24696	Complete Tobacco Manure (from Carbonate)	Glastonbury (2)	3
24367	*Grass and Lawn Top Dressing	Meriden, Stafford Springs	3
24533	" " " " "	Wapping	3
24547	" " " " "	So. Manchester	3
24809	Grass and Oats Fertilizer	Wallingford, Milford	1
24747	H. G. Tobacco Manure	Wapping	4
24503	Tobacco Starter and Grower	New Milford, Hazardville	3
	Bradley Branch.		
24369	Complete Manure for Potatoes and Vegetables	Meriden, Norwich Town, Stafford Springs	3
24633	Complete Manure for Top Dressing, Grass and Grain	Hazardville	3
24368	Corn Phosphate	Windsor Locks, Norwich Town, Stafford Springs	3
24600	Eclipse Phosphate	Milford, Putnam	2
24472	Farmers' New Method Fertilizer	Meriden, Stafford Springs, Middletown	3
24599	Niagara Phosphate	Middletown, Putnam	2
24434	Potato Fertilizer	Stafford Springs, Rockville, New Milford	3
24335	Potato Manure	Bristol, Windsor Locks, Suffield	3
24370	Superphosphate	Bristol, Windsor Locks, Norwich Town	3
	Church Branch.		
24505	Fish and Potash	Meriden, Middletown	2
	Crocker Branch.		
24748	Ammoniated Corn Phosphate	So. Coventry	3
24749	Potato, Hop and Tobacco Fertilizer	So. Coventry	3
	Darling Branch.		
24601	Dissolved Bone and Potash	Southington, Wallingford	3
24671	Farm Favorite	Wallingford, Clinton	3
4670	General Fertilizer	Wallingford, Clinton	2
4	Potato Manure	Wallingford (2), So. Manchester	3

note on page 404.

Analyses and Valuations.

	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Guaranteed.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Guaranteed.	So-called "Available." Found.	Guaranteed.	Potash. Found. As Muriate.	Total.	Guaranteed.
…4	46.8	0.36	2.11	1.07	3.54	3.3	5.28	1.47	0.89	7.64	7.0	6.75	6.0	9.93	9.93	10.…
…5	25.4	....	0.20	4.37	4.57	4.5	0.50	5.33	2.46	8.29	4.0	5.83	3.0	1.50	5.71	5.…
…4	24.6	....	0.18	4.14	4.32	4.5	0.41	5.67	2.70	8.78	4.0	6.08	3.0	1.61	5.59	5.…
…6	28.9	0.14	0.10	4.24	4.48	4.5	0.13	5.01	3.79	8.93	4.0	5.14	3.0	0.41	†3.80	5.…
…7	73.9	2.96	0.18	0.65	3.79	3.9	2.80	3.93	1.25	7.98	6.0	6.73	5.0	2.57	2.57	2.…
…3	78.8	2.18	1.22	0.36	3.76	3.9	5.11	0.79	0.19	6.09	6.0	5.90	5.0	2.28	2.28	2.…
…7	62.2	2.13	1.52	0.25	3.90	3.9	2.98	4.31	0.92	8.21	6.0	7.29	5.0	2.82	2.82	2.…
…9	53.4	....	....	....	....	..	9.31	2.15	1.15	12.61	12.0	11.46	11.0	2.34	2.34	2.…
…7	39.0	....	3.08	2.44	5.52	5.8	4.54	1.74	0.32	6.60	6.0	6.28	5.0	1.49	10.23	10.…
…3	54.7	....	2.14	1.42	3.56	3.3	6.05	3.10	0.93	10.08	9.0	9.15	8.0	0.66	4.16	4.…
…9	45.1	0.90	1.30	1.14	3.34	3.3	6.90	1.76	1.47	10.13	9.0	8.66	8.0	6.50	7.17	7…
…3	68.1	1.19	3.00	0.55	4.74	4.9	4.57	1.16	0.28	6.01	6.0	5.73	5.0	2.87	2.87	2…
…8	79.3	0.26	0.80	1.11	2.17	2.1	6.65	2.51	1.50	10.66	9.0	9.16	8.0	1.83	1.83	1…
…0	98.8	0.15	0.44	0.69	1.28	1.0	6.55	2.23	1.05	9.83	9.0	8.78	8.0	2.17	2.17	2…
…2	64.0	0.23	0.68	1.05	1.96	1.7	6.96	2.11	1.34	10.41	9.0	9.07	8.0	3.15	3.15	3…
…9	107.9	0.15	0.42	0.63	1.20	0.8	6.13	2.44	1.19	9.76	8.0	8.57	7.0	1.67	1.67	1…
…4	65.6	0.42	0.72	1.04	2.18	2.1	7.02	2.53	1.43	10.98	9.0	9.55	8.0	3.07	3.07	3…
…5	63.5	0.10	1.55	1.03	2.68	2.5	4.94	1.97	0.70	7.61	7.0	6.91	6.0	5.08	5.08	5…
…0	59.0	0.37	1.20	1.05	2.62	2.5	7.54	2.32	1.10	10.96	10.0	9.86	9.0	2.32	2.32	2…
…5	55.3	....	0.40	1.98	2.38	2.1	4.33	2.60	1.01	7.94	7.0	6.93	6.0	2.50	2.50	5…
…8	73.2	0.38	0.90	0.92	2.20	2.1	7.34	2.20	1.22	10.76	9.0	9.54	8.0	1.48	1.48	1…
…9	60.9	0.69	0.85	0.67	2.21	2.1	7.26	2.37	0.92	10.55	9.0	9.63	8.0	3.36	3.36	…
…1	49.7	0.13	1.20	1.23	2.56	2.5	5.29	2.37	0.76	8.42	7.0	7.66	6.0	10.09	10.09	1…
…1	74.2	0.13	1.10	0.97	2.20	2.1	6.44	2.38	0.90	9.72	9.0	8.82	8.0	3.09	3.09	…
…0	86.7	0.21	0.31	0.86	1.38	1.2	4.65	2.00	1.12	7.77	7.0	6.65	6.0	4.31	4.31	…
…4	72.2	....	1.68	0.85	2.53	2.5	5.18	1.98	0.55	7.71	7.0	7.16	6.0	5.31	5.31	…

† 1.71 per cent. potash as sulphate, 1.68 per cent. as carbonate.

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.
	Sampled by Station Agent:		
	East India Branch.		
24602	A. A. Ammoniated Superphosphate	New Haven, So. Manchester	$33.50
24750	Potato Manure	So. Manchester	38.00
	Great Eastern Branch.		
24729	General	Madison	31.00
24646	H. G. Vegetable, Vine and Tobacco Fertz.	East Hampton, Rocky Hill	34.00
24634	*Northern Corn Special	East Hampton, Granby	32.00
24850	" " "	East Lyme	33.00
	North Western Branch.		
24336	Fish, Bone and Potash	New Haven, Bristol, Suffield	30.50
24435	Market Garden Phosphate	Southport, New Milford	33.50
24410	10% Potato Fertilizer	New Haven, Waterbury, Southport, Milford	35.00
24535	Universal Fertilizer	Suffield, Avon	32.50
	Packers' Union Branch.		
24604	Animal Corn Fertilizer	Somerville, Waterford	31.00
24605	*Gardeners' Complete Manure	New Canaan, Granby	37.00
24851	" " "	Watertown	37.0
24603	Potato Manure	New Canaan, Somerville	34.0
24751	Universal Fertilizer	East Hampton	29.0
	Quinnipiac Branch.		
24768	Climax Phosphate	Plainfield	28.0
24606	Corn Manure	Westport, Plainfield	30.0
24412	Market Garden Manure	Southport, Westport, Norwalk	36.5
24460	Phosphate	New London, Westport	32.5
24411	Potato Manure	New London, Southport, Westport	31.7
24769	Potato Phosphate	New London	31.0
	Read Branch.		
24461	Practical Potato Special	New Canaan, Wilton	31.5
24673	Standard Superphosphate	W. Hartford, So. Meriden	30.0
24672	Vegetable and Vine Fertilizer	East Canaan, So. Meriden	33.5
	Wheeler Branch.		
24607	Corn Fertilizer	Granby, So. Coventry	30.0
24810	Grass and Oats	New Canaan, Granby	22.5
24697	*Havana Tobacco Grower	East Granby, Granby	36.0
24886	" " "	East Granby	35.0
24608	Potato Manure	New Canaan, Granby	31.5
	Williams and Clark Branch.		
	Americus Ammoniated Bone Superphosphate	Waterbury	35.[illegible]
	[illegible]ericus Corn Phosphate	Milford, Wallingford, Wapping	31.[illegible]

ANALYSES AND VALUATIONS—*Continued.*

Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
63.3	0.29	1.24	1.14	2.67	2.5	7.03	3.05	1.10	11.18	10.0	10.08	9.0	2.17	2.17	2.0
50.2	----	2.05	1.05	3.10	3.3	5.41	1.25	0.38	7.04	7.0	6.66	6.0	7.97	9.72	10.0
100.5	----	0.22	0.88	1.10	0.8	7.21	1.26	1.16	9.63	9.0	8.47	8.0	3.86	3.86	4.0
65.5	0.32	0.80	1.03	2.15	2.1	6.56	1.99	1.11	9.66	9.0	8.55	8.0	5.78	5.78	6.0
68.7	0.58	0.78	0.64	2.00	2.5	7.43	2.77	2.75	12.95	10.0	10.20	9.0	2.40	2.40	2.0
58.5	0.82	0.76	1.18	2.76	2.5	6.92	2.27	1.65	10.84	10.0	9.19	9.0	2.75	2.75	2.0
71.3	----	0.26	2.23	2.49	2.5	2.88	1.79	0.83	5.50	5.0	4.67	4.0	4.37	4.37	4.0
51.1	----	1.07	1.37	2.44	2.5	7.30	1.48	0.47	9.25	9.0	8.78	8.0	6.27	6.27	6.0
45.3	----	0.92	1.02	1.94	1.7	6.33	2.53	1.07	9.93	9.0	8.86	8.0	10.49	10.49	10.0
52.4	----	1.07	1.38	2.45	2.5	7.27	2.46	0.94	10.67	9.0	9.73	8.0	4.10	4.10	4.0
64.2	0.73	1.00	0.78	2.51	2.5	7.30	1.75	1.16	10.21	10.0	9.05	9.0	2.11	2.11	2.0
46.9	----	1.80	0.99	2.79	2.5	5.51	1.81	1.20	8.52	7.0	7.32	6.0	2.67	8.98	10.0
45.1	0.09	1.22	0.73	2.04	2.5	5.80	1.57	3.63	11.00	7.0	7.37	6.0	1.36	10.66	10.0
62.7	0.41	0.99	0.90	2.30	2.1	6.74	1.76	1.07	9.57	9.0	8.50	8.0	5.78	5.78	6.0
79.6	0.08	0.70	0.32	1.10	0.8	6.19	2.78	1.87	10.84	9.0	8.97	8.0	4.51	4.51	4.0
72.0	0.20	0.65	0.89	1.74	1.1	6.80	2.01	1.02	9.83	9.0	8.81	8.0	2.19	2.19	2.0
65.8	0.85	0.77	0.76	2.38	2.1	5.95	2.88	1.39	10.22	9.0	8.83	8.0	1.94	1.94	1.5
39.4	----	2.27	1.11	3.38	3.3	6.91	1.98	1.00	9.89	9.0	8.89	8.0	7.39	7.39	7.0
56.7	0.56	1.10	1.07	2.73	2.5	8.11	1.88	1.24	11.23	10.0	9.99	9.0	2.18	2.18	2.0
47.8	0.70	0.72	1.20	2.62	2.5	5.82	1.88	0.83	8.53	7.0	7.70	6.0	5.97	5.97	5.0
53.8	0.76	0.79	0.80	2.35	2.1	8.07	2.10	1.28	11.45	9.0	10.17	8.0	2.99	2.99	3.0
107.4	----	0.15	0.83	0.98	0.8	3.68	1.33	0.80	5.81	5.0	5.01	4.0	7.88	7.88	8.0
86.7	----	0.40	0.69	1.09	0.8	7.06	2.10	1.82	10.98	9.0	9.16	8.0	3.85	3.85	4.0
64.8	----	1.20	0.78	1.98	2.1	6.84	1.65	1.26	9.75	9.0	8.49	8.0	6.34	6.34	6.0
79.3	0.22	0.73	0.89	1.84	1.7	7.18	1.88	0.94	10.00	9.0	9.06	8.0	2.11	2.11	2.0
81.5	----	---	---	----	---	8.49	2.41	2.70	13.60	12.0	10.90	11.0	2.06	2.06	2.0
44.5	----	1.94	0.74	2.68	2.5	5.62	1.49	1.13	8.24	7.0	7.11	6.0	1.25	9.24	10.0
32.4	0.12	1.24	1.21	2.57	2.5	5.93	1.72	1.22	8.87	7.0	7.65	6.0	1.62	10.30	10.0
63.1	0.09	1.68	0.49	2.26	2.1	7.12	2.05	1.81	10.98	9.0	9.17	8.0	3.42	3.42	3.0
70.6	----	1.31	1.43	2.74	2.5	6.81	2.91	1.24	10.96	10.0	9.72	9.0	1.94	1.94	2.0

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.
	Sampled by Station Agent: Williams and Clark Branch (Continued).		
24647	Americus H. G. Special Fertilizer	Plainville, Wapping	$38.0
24648	Americus Potato Manure	*Milford, Collinsville*	31.5
24609	Potato Phosphate	Waterbury, Wallingford	34.5
	The Armour Fertilizer Works, Baltimore, Md.		
24413	All Soluble	New Haven, Willimantic, Norwalk	33.5
24462	Ammoniated Bone with Potash	Willimantic, Danbury	30.0
24506	Bidwell's Formula for all Crops	Windsor Locks	30.0
24635	Bone, Blood and Potash	Thompsonville, Bridgeport	38.2
24559	*Complete Potato*	*Branford, Danbury, Putnam*	32.0
24610	Corn King	Danbury, Putnam	29.5
24473	Fish and Potash	Branford, Norwalk, Meriden	27.2
24537	Fruit and Root Crop Special	Danbury, Meriden	27.5
24436	Market Garden	New Haven, Branford, Danbury	36.5
24414	High Grade Potato	New Haven, Willimantic, Norwalk	33.7
24852	*Wheat, Corn and Oats Special*	*Colchester*	25.0
	Atlantic Fertilizer Co., Baltimore, Md.		
24475	*Early Truck and Vegetable Manure	Leonard's Bridge	26.0
24474	*H. G. Truck and Potato Special	Leonard's Bridge	30.0
	Berkshire Fertilizer Co., Bridgeport, Conn.		
24561	Ammoniated Bone Phosphate	Danbury, Waterbury, Stafford	28.7
24507	Complete Fertilizer	Southport, Waterbury, Plantsville	34.0
24611	Grass Special	Stafford, Yantic	36.5
24538	Long Island Special	Southport, Plantsville	35.0
24560	Potato and Vegetable Phosphate	Danbury, Waterbury, Stafford	31.2
24730	Tobacco Special	Glastonbury, Bridgeport	35.5
	F. E. Boardman, Westfield, Conn. *(Made for)*		
24548	Complete Fertilizer	Westfield	34.0
	Bowker Fertilizer Co., New York City.		
24772	Bone and Wood Ash Fertilizer	New Haven	30.0
24649	Complete Alkaline Tobacco Grower	Thompsonville, Silver Lane, Ellington	34.2

* Bought from manufacturer. Brand not entered for sale in this State.

ANALYSES AND VALUATIONS—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	
1647	49.4	0.49	2.24	0.70	3.43	3.3	7.23	1.25	0.58	9.06	9.0	8.48	8.0	7.24	7.24	
1648	74.7	0.52	0.90	0.69	2.11	2.1	6.85	1.96	0.75	9.56	9.0	8.81	8.0	3.16	3.16	
1609	74.9	0.06	1.76	0.82	2.64	2.5	5.28	1.70	0.40	7.38	7.0	6.98	6.0	5.12	5.12	
1413	54.7	1.19	0.72	1.10	3.01	2.9	6.84	2.16	0.56	9.56	8.5	9.00	8.0	3.57	3.57	
1462	69.6	0.93	0.24	1.15	2.32	2.5	5.46	1.89	0.86	8.21	6.5	7.35	6.0	3.03	3.03	
1506	30.9	0.49	0.25	1.79	2.53	2.5	6.92	2.07	0.59	9.58	8.5	8.99	8.0	4.45	5.92	
1635	34.5	1.70	0.19	2.04	3.93	4.1	6.82	1.80	0.54	9.16	8.5	8.62	8.0	7.57	7.57	
1559	65.2	1.10	0.20	0.58	1.88	1.7	7.23	1.35	0.30	8.88	7.5	8.58	7.0	6.09	6.09	
1610	46.0	1.43	0.14	0.43	2.00	2.5	7.79	1.36	0.43	9.58	8.5	9.15	8.0	6.11	6.11	
1473	67.4	0.60	0.16	1.30	2.06	2.1	5.06	1.77	1.11	7.94	6.5	6.83	6.0	2.63	2.63	
1537	40.2	1.02	0.12	0.81	1.95	1.7	7.37	1.64	0.44	9.45	8.5	9.01	8.0	5.43	5.43	
1436	45.1	1.06	0.70	1.48	3.24	3.3	6.65	1.69	0.58	8.92	8.5	8.34	8.0	7.10	7.10	
1414	52.5	0.58	0.15	0.70	1.43	1.7	7.33	1.69	0.63	9.65	8.5	9.02	8.0	10.34	10.34	1
1852	63.7	0.28	0.10	1.20	1.58	0.8	6.52	1.97	0.50	8.99	8.5	8.49	8.0	1.88	1.88	
1475	18.7	....	1.58	1.52	3.10	3.3	2.92	3.06	1.34	7.32	...	5.98	6.0	6.05	6.05	
1474	16.9	0.71	0.88	0.93	2.52	3.3	8.68	1.36	0.55	10.59	...	10.04	8.0	9.11	9.11	1
1561	83.7	0.19	0.09	1.12	1.40	0.8	6.93	1.91	0.65	9.49	9.0	8.84	8.0	2.63	2.63	
1507	43.1	0.56	0.70	1.48	2.74	2.5	6.49	2.18	0.54	9.21	9.0	8.67	8.0	7.07	7.07	
1611	42.2	2.35	1.03	1.84	5.22	5.0	2.76	2.18	0.54	5.48	5.0	4.94	4.0	3.58	3.58	
1538	31.7	....	1.69	1.88	3.57	3.3	4.89	2.24	0.49	7.62	7.0	7.13	6.0	8.53	8.53	
1560	79.2	0.23	1.00	0.87	2.10	1.7	4.73	1.42	0.35	6.50	7.0	6.15	6.0	5.27	5.27	
1730	42.5	....	1.60	2.32	3.92	4.1	2.94	2.14	0.68	5.76	4.0	5.08	3.0	1.09	6.05	
1548	19.8	0.59	0.48	2.29	3.36	2.9	5.28	2.40	0.47	8.15	---	7.68	7.0	10.51	10.51	1
1772	90.2	....	0.15	1.57	1.72	1.7	1.50	5.42	2.74	9.66	7.0	6.92	6.0	2.61	2.61	
1649	22.4	0.40	0.10	3.72	4.22	4.1	1.10	4.18	3.76	9.04	5.0	5.28	4.0	0.73	5.78	

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.
	Sampled by Station Agent: **Bowker Fertilizer Co.** *(Continued).*		
24775	Complete Alkaline Tobacco Grower (with Carbonate)	West Suffield	$35.50
24539	Corn Phosphate	Rockville, Sharon	29.00
24437	Early Potato Manure	Wethersfield, Yalesville, So. Norwalk	37.25
24540	Farm and Garden Phosphate	Hazardville, Meriden	27.00
24337	Fisherman's Brand Fish and Potash	Waterbury, Wethersfield, Meriden	27.50
24415	Gloucester Fish and Potash	New Haven, Yalesville	25.00
24338	Hill and Drill Phosphate	Waterbury, Hazardville, Yalesville	34.00
24773	Lawn and Garden Dressing	New Haven	50.00
24463	Market Garden Fertilizer	Wethersfield, Yalesville, Sharon	36.50
24373	Potato and Vegetable Fertilizer	Hazardville, Yalesville, Yantic	34.25
24562	Potato and Vegetable Phosphate	Rockville, Danielson, Norwich	31.75
24464	Sure Crop Phosphate	Yalesville, Yantic, Sharon	26.75
24699	*Tobacco Ash Elements	West Suffield, Suffield, Silver Lane	33.00
25050	" " "	Hazardville	35.00
24698	Tobacco Starter	Hazardville, Silver Lane	36.50
24371	Stockbridge Spec. Comp. Manure for Corn and All Grain Crops	Yantic, Meriden, Rockville	38.00
24339	Stockbridge Spec. Comp. Manure for Potatoes and Vegetables	New Haven, Waterbury, Wethersfield	40.00
24636	Stockbridge Spec. Comp. Manure for Seeding Down, etc.	Sharon	35.00
24372	Stockbridge Spec. Comp. Manure for Top Dressing and for Forcing	Wethersfield, Meriden, Rockville	38.00
24774	Stockbridge Spec. Comp. Manure for Tobacco	Wapping	48.00
	The Buffalo Fertilizer Co., Buffalo, N. Y.		
24361	Celery and Potato Special	Plainville, West Cheshire, Westville	33.50
24375	Farmer's Choice	Plainville, Westville, Norwich Town	25.00
24417	Fish Guano	Westville, Manchester, Branford	24.25
24416	High Grade Manure	Plainville, West Cheshire, Manchester	36.50
24542	New England Special	Plainville	29.00
24731	Tobacco Producer	West Suffield, East Windsor Hill	38.00

* See note on page 404. † 3.35 per cent. potash as sulphate, 2.52 per cent. as carbon

ANALYSES AND VALUATIONS—*Continued.*

	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
5	20.9	1.04	0.06	3.07	4.17	4.1	0.68	5.02	3.24	8.94	5.0	5.70	4.0	0.31	†6.18	5.0
9	67.9	0.30	0.75	0.80	1.85	1.7	6.76	2.73	1.36	10.85	9.0	9.49	8.0	2.25	2.25	2.0
7	43.8	----	1.47	1.84	3.31	3.3	5.91	2.36	1.20	9.47	8.0	8.27	7.0	7.23	7.23	7.0
0	63.5	----	0.56	1.06	1.62	1.7	5.43	3.72	1.88	11.03	9.0	9.15	8.0	2.19	2.19	2.0
7	47.0	0.26	0.58	1.69	2.53	2.5	3.24	2.33	1.22	6.79	5.0	5.57	4.0	4.69	4.69	4.0
5	74.8	0.10	0.10	0.84	1.04	0.8	6.84	2.92	1.42	11.18	9.0	9.76	8.0	1.45	1.45	1.0
8	68.7	0.11	1.92	0.55	2.58	2.5	7.44	2.67	1.43	11.54	10.0	10.11	9.0	2.41	2.41	2.0
3	----	0.83	1.92	0.33	3.08	3.3	2.53	2.44	0.63	5.60	8.0	4.97	4.0	5.43	5.43	5.0
3	42.5	0.09	1.23	1.48	2.80	2.5	5.37	2.08	1.16	8.61	7.0	7.45	6.0	10.01	10.01	10.0
3	59.7	0.34	1.12	1.16	2.62	2.5	6.33	2.74	1.38	10.45	9.0	9.07	8.0	4.35	4.35	4.0
2	87.6	0.34	0.66	0.82	1.82	1.7	6.56	2.78	1.57	10.91	9.0	9.34	8.0	1.99	1.99	2.0
4	82.8	----	0.10	0.88	0.98	0.8	7.20	2.44	1.50	11.14	10.0	9.64	9.0	2.07	2.07	2.0
9	45.9	----	---	---	----	--	1.44	7.35	4.67	13.46	----	8.79	6.0	1.06	13.73	15.0
0	48.5	----	---	---	----	--	1.88	9.15	4.32	15.35	----	11.03	6.0	0.51	12.91	15.0
8	70.8	0.26	1.26	1.08	2.60	2.5	6.49	2.58	0.92	9.99	9.0	9.07	8.0	0.96	3.05	3.0
1	40.3	1.07	1.65	0.66	3.38	3.3	8.52	2.01	0.87	11.40	11.0	10.53	10.0	7.20	7.20	7.0
9	46.7	0.83	0.94	1.63	3.40	3.3	4.17	2.62	1.55	8.34	7.0	6.79	6.0	10.12	10.12	10.0
6	43.6	0.11	1.40	1.09	2.60	2.5	5.21	2.01	0.92	8.14	9.0	7.22	6.0	10.02	10.02	10.0
2	37.5	1.21	1.50	2.17	4.88	4.9	2.87	2.81	0.63	6.31	6.0	5.68	4.0	6.12	6.12	6.0
4	46.7	1.05	3.49	1.01	5.55	5.8	3.14	1.32	0.67	5.13	5.0	4.46	4.0	1.30	10.17	10.0
1	57.1	0.80	0.40	0.73	1.93	1.6	4.90	3.46	1.16	9.52	9.0	8.36	8.0	8.14	8.14	10.0
5	42.1	0.10	0.35	0.87	1.32	0.8	5.68	3.46	1.41	10.55	9.0	9.14	8.0	4.72	4.94	5.0
7	*51.5*	*0.52*	*0.12*	*0.63*	*1.27*	*0.8*	*5.60*	*3.61*	*1.22*	*10.43*	*10.0*	*9.21*	*9.0*	*3.56*	*3.56*	*2.0*
5	32.6	1.17	1.15	1.19	3.51	3.3	4.57	2.75	0.83	8.15	8.0	7.32	7.0	10.23	10.23	10.0
2	41.4	----	0.54	1.44	1.98	1.6	3.20	6.03	2.35	11.58	10.0	9.23	9.0	5.15	5.15	5.0
1	46.4	0.50	0.74	2.86	4.10	4.5	2.67	2.41	0.88	5.96	6.0	5.08	5.0	6.90	6.90	5.5

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	[illegible]
	Sampled by Station Agent: **The Buffalo Fertilizer Co.** *(Continued).*			
1541	Top Dresser	West Cheshire, Manchester	$41.00	$3c
1374	Vegetable and Potato	Plainville, West Cheshire, Norwich Town	33.50	22
	The E. D. Chittenden Co., Bridgeport, Conn.			
1732	Connecticut Tobacco Grower	Broad Brook (2)	45.50	32
1740	Dissolved Bone Phosphate	Milford, Broad Brook	28.50	17
1735	Fish and Potash	Broad Brook (2)	28.00	2c
738	Grass and Grain	Broad Brook	36.00	27
1739	High Grade Potato	Milford	38.00	27
737	Potato and Grain	Broad Brook	30.00	24
1736	Potato Manure	Broad Brook (2)	30.00	21
734	Tobacco Grower	Broad Brook (2)	34.00	25
733	Tobacco Special	Broad Brook (2)	34.50	25
	The Everett B. Clark Seed Co., Milford, Conn.			
418	Special Mixture for General Use	Milford	31.00	26
438	10% Brand	Milford	34.00	28
	The Coe-Mortimer Co., New York City.			
637	Celebrated Special Potato Fertilizer	West Hartford, Torrington	33.50	18
776	Genuine Peruvian Guano, Lobos Grade	So. Norwalk, Wethersfield	36.50	25
543	Gold Brand Excelsior Guano	West Hartford, Southington	32.00	21
563	H. G. Ammoniated Bone Superphosphate	West Hartford, Somerville, Norwich	32.25	17
638	New Englander Corn and Potato Fertilizer	Riverton, Winsted, Torrington	28.00	13
777	Peruvian Vegetable Grower	Cheshire	43.00	29
549	Red Brand Excelsior Guano	Cheshire, Wilton, Somerville	37.50	26
700	*Tobacco and Onion Special	Somerville	37.00	25
	Conn. Valley Orchard Co., Berlin, Conn.			
360	H. G. Complete Fertilizer	Berlin	27.00	21
	Peter Cooper's Glue Factory, New York City.			
650	†Sterling H. G. Potato and Tobacco Fertilizer	East Canaan	23.00	21
	T. H. Eldredge, Norwich, Conn. *(Made for)*			
362	Fish and Potash	Norwich	28.00	18
363	Special Superphosphate	Norwich	27.00	15

Analyses and Valuations—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.
4541	32.8	1.35	2.26	2.19	5.80	5.7	4.34	2.34	0.82	7.50	7.0	6.68	6.0	5.23	5.23
4374	45.8	0.85	1.15	0.73	2.73	2.4	5.40	2.82	0.52	8.74	9.0	8.22	8.0	7.44	7.44
4732	38.1	0.34	2.24	2.50	5.08	5.0	1.04	4.43	1.02	6.49	6.0	5.47	4.0	0.80	9.92
4740	62.8	....	0.92	0.66	1.58	1.7	5.36	3.78	4.01	13.15	10.0	9.14	8.0	2.93	2.93
4735	36.1	0.13	1.18	1.41	2.72	2.5	6.09	1.06	1.55	8.70	6.0	7.15	--	4.45	4.45
4738	30.1	0.11	3.50	0.57	4.18	4.1	5.72	1.29	1.66	8.67	8.0	7.01	6.0	8.25	8.25
4739	37.6	....	2.88	1.00	3.88	4.1	6.22	2.01	1.94	10.17	10.0	8.23	8.0	7.53	7.53
4737	21.8	....	2.06	1.09	3.15	3.3	7.62	1.73	2.15	11.50	10.0	9.35	8.0	5.40	5.40
4736	40.8	....	1.27	0.73	2.00	2.0	7.43	1.45	1.70	10.58	10.0	8.88	8.0	6.81	6.81
4734	35.6	0.17	2.32	0.81	3.30	3.3	8.12	1.62	1.51	11.25	10.0	9.74	8.0	0.44	4.74
4733	37.3	....	2.47	1.43	3.90	4.5	6.42	1.18	1.25	8.85	3.0	7.60	3.0	2.37	4.65
4418	15.8	1.40	1.12	1.03	3.55	3.3	6.25	2.97	0.68	9.90	....	9.22	8.0	7.44	7.44
4438	21.4	1.51	1.12	1.13	3.76	3.3	3.73	3.60	1.00	8.33	....	7.33	6.0	9.92	9.92
4637	81.6	0.08	0.21	1.50	1.79	1.7	5.83	2.69	1.02	9.54	9.0	8.52	8.0	4.37	4.37
4776	41.6	0.43	0.42	1.80	2.65	2.9	2.39	9.19	2.93	14.51	14.0	11.58	8.0	1.44	5.41
4543	47.7	0.06	1.29	1.05	2.40	2.5	5.73	2.42	1.07	9.22	11.0	8.15	8.0	6.61	6.61
4563	81.8	....	0.18	1.67	1.85	1.9	5.46	3.14	1.16	9.76	9.0	8.60	8.0	3.06	3.06
4638	102.9	....	0.22	0.73	0.95	0.8	5.26	2.91	1.32	9.49	8.5	8.17	7.5	3.05	3.05
4777	47.6	0.61	0.79	1.92	3.32	3.3	4.70	3.86	0.52	9.08	10.0	8.56	8.0	1.18	9.63
4549	41.7	0.46	1.40	1.64	3.50	3.3	5.15	3.27	1.25	9.67	9.0	8.42	8.0	7.29	7.29
4700	42.6	2.16	0.16	1.36	3.68	3.3	3.53	3.43	1.00	7.96	7.0	6.96	6.0	1.12	6.94
4360	24.1	0.17	1.60	0.91	2.68	2.5	7.43	2.28	1.29	11.00	10.0	9.71	9.0	4.04	4.04
4650	7.6	0.11	1.61	0.43	2.15	1.7	6.34	1.88	2.28	10.50	9.0	8.22	8.0	7.11	7.11
4362	51.2	0.06	0.30	1.92	2.28	1.7	3.01	2.81	1.54	7.36	6.0	5.82	5.0	4.83	4.83
4363	74.4	0.05	0.10	1.20	1.35	1.0	3.61	4.87	1.70	10.18	10.0	8.48	8.0	2.79	2.79

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.
	Sampled by Station Agent:		
	Essex Fertilizer Co., Boston, Mass.		
24593	Complete Manure for Corn, Grain and Grass	East Hartford, Plainville	$41.00
24508	Complete Manure for Potatoes, Roots and Vegetables	East Hartford, Suffield, Plainville	41.00
24511	Fertilizer for Grass and Top Dressing	East Hartford, So. Manchester, Poquonock	45.75
24509	Market Garden and Potato Manure	East Hartford, Windsor Locks, Plainville	35.75
24550	Special Tobacco Manure	So. Manchester, Hazardville, East Hartford	45.75
24701	Tobacco Starter and Grower	E. Hartford, Broad Brook	38.50
24510	XXX Fish and Potash	East Hartford, Suffield, Plainville	32.25
	The L. T. Frisbie Co., New Haven, Conn.		
24341	Corn and Grain Fertilizer	Hartford	29.00
24340	Potato Manure	Hartford	32.00
	Germofert Manufacturing Co., Charleston, S. C.		
24674	Patented Potato Manure	Saybrook Pt.	36.00
24752	Patented Special Cotton Grower	Fairfield	36.00
	Lister's Agricultural Chemical Works, Newark, N. J.		
24778	Ammoniated Dissolved Bone Phosphate	Stafford Springs	34.00
24702	*Complete Tobacco Manure	Burnside, Glastonbury	37.00
24585	Corn and Potato Fertilizer	Stafford Springs, East Canaan, Wallingford	31.75
24551	Potato Manure	East Canaan, Glastonbury, Burnside	38.75
24779	Special Grass Mixture	East Canaan, Glastonbury	35.50
24586	Standard Pure Bone Superphosphate of Lime	Suffield, Wallingford (2)	32.00
24612	Success Fertilizer	Stafford Springs, E. Canaan	32.00
24782	3-6-10 for Potatoes	Suffield	35.00
	E. Manchester & Sons, Winsted, Conn. *(Made for)*		
24565	Formula	Winsted, Gilead (2)	30.00
24564	Special	Winsted, Gilead (2)	34.00
	The Mapes Formula and Peruvian Guano Co., New York City.		
24342	Average Soil Complete Manure	Hartford, Windsor Locks, Meriden	38.00
24552	Cereal Brand	Milford, Hartford	30.00

* See note, page 405.

Analyses and Valuations—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed
93	49.2	....	0.60	2.78	3.38	3.3	4.53	1.87	1.01	7.41	7.0	6.40	6.0	9.95	9.95	1[illegible]
08	47.3	....	0.50	2.90	3.40	3.3	4.53	2.04	0.90	7.47	7.0	6.57	6.0	10.07	10.07	1[illegible]
11	46.4	....	0.60	3.76	4.36	4.1	5.39	2.31	0.78	8.48	8.0	7.70	7.0	8.57	8.57	8
09	67.3	....	0.40	1.96	2.36	2.0	6.57	2.42	0.43	9.42	9.0	8.99	8.0	4.98	4.98	5
50	44.9	0.85	0.08	3.17	4.10	4.1	3.88	3.20	1.18	8.26	7.0	7.08	6.0	1.29	9.75	1[illegible]
01	43.8	0.83	0.08	3.31	4.22	4.1	1.61	3.21	0.63	5.45	5.0	4.82	4.0	0.69	6.39	6
10	74.9	....	0.02	2.06	2.08	2.0	5.40	2.97	0.83	9.20	9.0	8.37	8.0	3.02	3.02	3
41	46.2	....	0.07	2.15	2.22	1.6	2.79	5.44	2.40	10.63	8.0	8.23	5.0	3.76	3.76	3
40	14.6	0.13	0.12	2.99	3.24	2.5	3.96	7.07	4.28	15.31	8.0	11.03	5.0	4.99	4.99	6
74	47.1	1.03	1.15	1.87	4.05	4.1	0.15	3.33	6.49	9.97	10.0	3.48	3.3	0.82	4.74	6
52	101.1	0.74	0.58	1.23	2.55	2.5	0.12	1.52	11.58	13.22	10.0	1.64	3.3	0.51	2.87	[illegible]
78	78.8	....	0.26	1.92	2.18	2.1	6.88	2.87	1.29	11.04	9.0	9.75	8.0	1.76	1.76	1
02	30.9	1.64	0.05	2.81	4.50	4.1	0.06	6.70	3.31	10.07	5.0	6.76	4.0	0.72	4.95	5
85	77.1	....	0.20	1.62	1.82	1.7	5.59	2.79	1.47	9.85	9.0	8.38	8.0	3.48	3.48	[illegible]
51	47.3	....	1.93	1.39	3.32	3.3	7.40	1.46	0.70	9.56	9.0	8.86	8.0	7.60	7.60	7
79	34.2	0.10	0.77	1.18	2.05	1.7	9.47	1.38	0.36	11.21	....	10.85	10.0	10.82	10.82	1[illegible]
86	59.3	....	1.10	1.38	2.48	2.5	7.84	1.94	0.93	10.71	10.0	9.78	9.0	2.43	2.43	2
12	89.5	....	0.17	1.38	1.55	1.2	6.83	2.85	1.25	10.93	10.0	9.68	9.0	2.24	2.24	2
82	39.9	....	0.93	1.55	2.48	2.5	3.82	3.40	1.59	8.81	7.0	7.22	6.0	10.62	10.62	1[illegible]
65	13.9	0.53	0.20	3.01	3.74	3.5	2.17	3.46	1.89	7.52	....	5.63	8.0	7.61	7.61	7
64	7.7	1.67	0.18	3.00	4.85	5.0	2.95	3.85	1.00	7.80	....	6.80	8.0	0.60	7.61	7
42	42.0	2.45	1.28	0.59	4.32	4.1	1.48	6.16	0.64	8.28	8.0	7.64	7.0	0.66	6.05	5
52	88.7	0.69	0.64	0.59	1.92	1.7	0.59	6.69	1.36	8.64	8.0	7.28	6.0	3.37	3.37	3

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash
	Sampled by Station Agent: **The Mapes Formula and Peruvian Guano Co.** *(Continued).*		
24465	Complete Manure "A" Brand	Meriden, Southington, Hartford	$3
24364	Corn Manure	Hartford, Meriden, Norwich	3
24811	Dissolved Bone	Hartford	3
24525	Economical Potato Manure	Hartford, Milford, Forestville	3
24783	Fruit and Vine	Hartford	4
24343	Potato Manure	Hartford, Windsor Locks, Suffield	40
24784	Seeding Down Manure	Forestville	4
24703	Tobacco Ash Constituents	Suffield, Hartford	3
24704	Tobacco Manure, Wrapper Brand	Hazardville, Suffield, Hartford	4
24554	Tobacco Starter, Improved	Hartford, Windsor Locks	3
24553	Top Dresser, Improved, Full Strength	Hartford, Forestville	5
24478	" " " Half Strength	Windsor Locks, Hartford, Middletown	3
24365	Vegetable Manure for Light Soils	Hartford, Meriden, Norwich	4
	The National Fertilizer Co., New York City.		
24555	Chittenden's Ammoniated Bone Phosphate	Willimantic, Silver Lane	30
24753	Chittenden's Complete Corn and Grain Fertilizer	East Windsor Hill	--
24785	Chittenden's Complete Grass Fertilizer	Greenwich	45
24527	" " Root Fertilizer	So. Manchester, Silver Lane	39
24556	" " Tobacco Fertz.	So. Manchester, New Milford	38
24786	* " Connecticut Valley Tobacco Grower	New Milford	48
24528	Chittenden's Eureka Potato Fertilizer	Willimantic, So. Manchester	36
24439	" Fish and Potash	West Cheshire, So. Manchester, Silver Lane	31
24787	" Formula "A"	Willimantic	3
24788	" Market Garden Fertilizer	Suffield	34
24440	" Potato Phosphate	Willimantic, Silver Lane, Greenwich	32
24812	" Soluble Bone and Potash	Wallingford	20
24705	" Tobacco Special	Suffield, Simsbury	35
24789	‖ " " " with Carbonate	Simsbury	36
24529	Chittenden's Universal Phosphate	Greenwich, Winsted	28
24526	" XXX Fish and Potash	So. Manchester, Winsted, Avon	28

* See note on page 428. † 4.72 per cent. potash as sulphate, 7.70 per cen bonate. ‡ 3.16 per cent. potash as sulphate, 5.25 per cent. as carbonate. · cent. potash as sulphate, 0.59 per cent. as carbonate. ‖ See note on page 405.

ANALYSES AND VALUATIONS—*Continued.*

	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
65	75.5	1.22	0.70	0.70	2.62	2.5	0.76	9.28	3.34	13.38	12.0	10.04	10.0	3.34	3.34	2.
64	63.3	0.56	1.16	0.82	2.54	2.5	0.92	7.60	2.70	11.22	10.0	8.52	8.0	6.93	6.93	6.
11	23.1	----	0.68	2.58	3.26	2.1	2.65	14.35	1.10	18.10	----	17.00	12.0	----	-----	---
25	42.5	1.48	1.30	0.94	3.72	3.3	0.69	4.81	1.11	6.61	6.0	5.50	4.0	1.08	9.08	8.
83	64.1	1.61	0.10	0.47	2.18	1.7	0.36	6.33	0.56	7.25	7.0	6.69	5.0	1.00	12.18	10.
43	47.1	1.88	1.50	0.50	3.88	3.7	1.52	7.21	1.11	9.84	8.0	8.73	8.0	0.72	7.41	6.
84	33.5	2.63	0.08	0.44	3.15	2.5	0.00	13.00	4.08	17.08	18.0	13.00	----	12.35	12.35	10.
03	31.6	----	0.02	0.80	0.82	0.5	0.00	4.07	2.77	6.84	5.7	4.07	----	1.82	†14.24	15.
04	25.7	4.50	0.04	1.89	6.43	6.2	0.07	4.19	1.59	5.85	4.5	4.26	----	1.50	‡ 9.91	10.
54	54.0	3.56	0.12	0.94	4.62	4.1	0.12	7.82	1.30	9.24	8.0	7.94	6.0	0.62	2.02	1.
53	28.4	5.51	3.61	0.43	9.55	9.9	0.34	7.03	0.88	8.25	8.0	7.37	----	1.04	4.25	4.
78	64.3	3.84	0.72	0.24	4.80	4.9	0.43	2.85	1.08	4.36	4.0	3.28	----	0.74	2.46	2.
65	39.9	2.45	2.30	0.57	5.32	4.9	0.81	6.71	1.00	8.52	8.0	7.52	6.0	0.98	7.63	6.
55	84.0	----	0.60	0.92	1.52	1.7	6.98	2.07	1.18	10.23	9.0	9.05	8.0	3.02	3.02	2.
53	----	---	2.26	0.94	3.20	3.3	5.43	3.12	1.34	9.89	9.0	8.55	8.0	5.94	5.94	6.
85	82.6	2.60	0.20	1.18	3.9[illegible]	4.1	4.54	2.84	0.67	8.05	7.0	7.38	6.0	5.11	5.11	5.
27	63.1	----	2.24	0.97	3.21	3.3	5.59	3.22	1.35	10.16	9.0	8.81	8.0	5.91	5.91	6.
56	51.8	----	2.58	0.77	3.35	3.3	6.72	2.38	1.25	10.35	9.0	9.10	8 0	0.70	5.34	5.
86	68.1	0.29	0.15	4.19	4.63	4.9	0.40	4.16	0.88	5.44	4.0	4.56	1.0	0.60	6.71	8.
28	45.3	0.51	1.34	0.93	2.78	2.5	4.44	2.16	0.92	7.52	7.0	6.60	6.0	10.62	10.62	10.
39	49.3	0.97	0.24	1.71	2.92	2.9	5.37	2.21	1.09	8.67	7.0	7.58	6.0	4.14	4.14	4.
87	34.1	1.43	0.94	0.88	3.25	3.3	6.34	1.72	1.24	9.30	7.0	8.06	6.0	6.94	6.94	6.
88	49.2	0.74	0.42	1.38	2.54	2.5	6.62	2.13	1.08	9.83	9.0	8.75	8.0	6.43	6.43	6.
40	46.3	0.51	1.08	0.86	2.45	2.1	7.00	2.03	1.03	10.06	9.0	9.03	8.0	6.50	6.50	6.
12	60.4	----	---	---		--	9.27	1.86	1.82	12.95	12.0	11.13	11.0	2.25	2.25	2.
05	23.0	----	0.90	3.85	4.75	4.5	0.34	4.61	2.75	7.70	4.0	4.95	3.0	0.85	5.21	5.
89	34.4	0.24	0.12	4.08	4.44	4.5	0.45	5.12	3.30	8.87	4.0	5.57	3.0	0.60	§ 3.60	5.
29	109.4	----	0.22	0.80	1.02	0.8	7.18	1.79	1.06	10.03	9.0	8.97	8.0	1.37	1.37	1.
26	48.5	0.54	0.32	1.65	2.51	2.5	4.90	1.89	0.98	7.77	6.0	6.79	5.0	3.76	3.76	3.

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.
	Sampled by Station Agent:			
	New England Fertilizer Co., Boston, Mass.			
24613	Corn and Grain Fertilizer	Rockville, Plantsville, Suffield	$29.75	$14.
24639	Corn Phosphate	Bristol, Collinsville	30.00	17.
24614	H. G. Potato Fertilizer	Bristol, Plantsville	35.50	22.
24706	Perfect Tobacco Grower	So. Manchester, Suffield, Collinsville	37.50	25.
24466	Potato Fertilizer	Bristol, Rockville, Plantsville	31.00	16.
24675	Potato Grower	Rockfall, Cromwell	35.50	24.
24615	Superphosphate	Bristol, East Woodstock, So. Manchester	32.50	21.
	Niantic Menhaden Oil & Guano Co., South Lyme, Conn.			
24791	Bone, Fish and Potash	East Haddam	30.00	19.
24793	Corn and Grain Fertilizer	East Haddam, Moodus	30.00	19.
24795	H. G. Tobacco Fertilizer	East Haddam	38.00	27.
24792	Market Garden Manure	Norwich	35.00	24.
24616	Potato and Vegetable Manure	Norwich, East Haddam	31.00	22.
	Olds & Whipple, Hartford, Conn.			
24640	Complete Corn and Potato Fertilizer	Hartford	34.00	28.
24796	Complete Tobacco Fertilizer	Hartford	37.00	30.
24344	Fish and Potash	Hartford	30.00	18.
24512	Grass Fertilizer	Hartford	34.00	26.
24345	H. G. Potato Fertilizer	Hartford	37.00	30.
24346	Special Phosphate	Hartford	35.00	25.
	Parmenter & Polsey Fertilizer Co., Boston, Mass.			
24797	5-4-8	Wallingford, Warehouse Point	37.50	30.
24479	Plymouth Rock Brand	Plantsville, Wallingford	33.00	20.
24594	Potato Fertilizer	Wallingford, So. Woodstock	31.00	19.
24798	Special Potato Fertilizer	Mansfield Depot	39.00	27.
	The Rogers & Hubbard Co., Middletown, Conn.			
24618	Hubbard's Bone Base Complete Phosphate	Wallingford, Moodus, Suffield	27.25	20.
24652	Hubbard's Bone Base Grass and Grain Fertilizer	Portland, Middletown	42.00	32.
24754	Hubbard's* Bone Base New Market Garden Phosphate	Middletown, Branford	35.50	24.
24651	Hubbard's Bone Base Oats and Top Dressing	Wallingford, Clinton	56.00	42.

* 1.28 per cent. potash as sulphate, 4.23 per cent. as carbonate.

ANALYSES AND VALUATIONS—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
24613	105.9	....	0.08	1.37	1.45	1.2	4.97	2.64	0.78	8.39	8.0	7.61	7.0	2.14	2.14	2.0
24639	69.2	....	0.32	1.53	1.85	1.6	6.24	2.38	1.03	9.65	9.0	8.62	8.0	3.13	3.13	3.0
24614	55.0	....	0.13	2.37	2.50	2.5	5.40	3.15	0.80	9.35	9.0	8.55	8.0	6.24	6.24	6.0
24706	44.8	0.78	0.10	3.12	4.00	4.1	1.84	3.28	0.74	5.86	5.0	5.12	4.0	0.93	6.15	6.0
24466	91.6	....	0.24	1.40	1.64	1.6	5.21	2.14	0.52	7.87	8.0	7.35	7.0	3.76	3.76	4.0
24675	47.2	....	0.06	2.32	2.38	2.5	4.02	2.89	0.65	7.56	7.0	6.91	6.0	9.95	9.95	10.0
24615	53.4	....	0.45	2.08	2.53	2.5	6.16	2.34	0.83	9.33	10.0	8.50	8.0	4.33	4.33	4.0
24791	55.6	....	0.54	2.09	2.63	2.5	2.37	3.10	2.65	8.12	6.0	5.47	5.0	4.14	4.14	3.0
24793	53.5	0.55	0.39	1.54	2.48	2.1	2.72	3.09	3.44	9.25	8.0	5.81	7.0	4.80	4.80	3.5
24795	39.2	0.80	0.50	2.12	3.42	3.3	3.50	3.96	2.85	10.31	8.0	7.46	7.0	0.90	7.33	6.0
24792	41.9	0.68	0.57	2.23	3.48	4.1	3.60	3.51	2.25	9.36	8.0	7.11	7.0	5.65	5.65	6.0
24616	40.6	1.08	0.31	1.31	2.70	2.5	3.11	3.75	3.31	10.17	8.0	6.86	7.0	6.17	6.17	4.0
24640	20.6	....	0.69	3.09	3.78	3.3	0.50	8.21	2.25	10.96	7.0	8.71	6.0	4.32	6.36	6.0
24796	20.9	0.57	0.15	3.98	4.70	4.5	0.12	4.21	0.58	4.91	3.5	4.33	3.0	0.74	*6.25	5.5
24344	65.8	....	0.16	2.34	2.50	2.5	0.08	4.96	3.33	8.37	6.0	5.04	5.0	3.35	3.35	3.0
24512	26.4	....	0.88	3.06	3.94	3.3	0.64	5.55	2.39	8.58	7.0	6.19	6.0	6.91	6.91	6.0
24345	21.7	....	0.56	3.05	3.61	3.3	0.38	6.66	2.66	9.70	7.0	7.04	6.0	6.53	10.65	10.0
24346	34.8	....	0.76	3.44	4.20	4.1	0.03	6.86	2.30	9.19	....	6.89	4.0	1.00	3.49	3.0
24797	23.6	0.85	0.14	3.25	4.24	4.1	2.62	2.96	0.75	6.33	5.0	5.58	4.0	0.97	9.30	8.0
24479	60.7	....	0.60	1.78	2.38	2.5	6.43	2.06	0.82	9.31	9.0	8.49	8.0	4.38	4.38	4.0
24594	58.3	....	0.10	1.78	1.88	1.6	4.26	2.76	0.67	7.69	7.0	7.02	6.0	6.86	6.86	6.0
24798	43.5	....	0.66	2.60	3.26	3.3	6.28	3.07	0.78	10.13	9.0	9.35	8.0	7.35	7.35	7.0
24618	36.0	0.58	0.05	1.00	1.63	1.5	5.56	4.40	0.67	10.63	8.0	9.96	7.0	6.15	6.15	5.0
24652	29.1	0.28	0.06	2.28	2.62	2.2	0.23	10.09	7.19	17.51	16.0	10.32	6.5	13.14	13.14	12.0
24754	46.0	1.01	0.08	1.05	2.14	2.0	3.59	4.76	0.99	9.34	7.0	8.35	6.0	10.81	10.81	10.0
24651	33.3	7.33	0.02	0.86	8.21	8.5	0.08	8.49	1.49	10.06	8.0	8.57	4.5	8.93	8.93	8.0

Nitrogenous Superphosphates.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.
	Sampled by Station Agent: **The Rogers & Hubbard Co.** *(Continued).*			
24653	Hubbard's Bone Base Potato Phosphate	Wallingford, Glastonbury	$33.00	$22.60
24587	" " " Soluble Corn and General Crops Manure	Wallingford, East Hampton, Moodus	37.25	24.88
24617	Hubbard's Bone Base Soluble Potato Manure	East Hampton, Clinton, Moodus	44.00	32.74
24707	Hubbard's Bone Base Soluble Tobacco Manure	Westbrook, Portland, Suffield	48.00	36.60
	The Rogers Mfg. Co., Rockfall, Conn.			
24655	All Round Fertilizer	Southington, Wallingford	30.50	17.78
24654	Complete Potato and Vegetable Fertz.	Suffield, Cromwell	33.50	23.23
24567	Fish and Potash	Norwalk, Burnside	33.00	21.87
24557	H. G. Complete Corn and Onion	Suffield, Southington, Cromwell	37.50	28.10
24656	H. G. Grass and Grain Fertilizer	Wapping, Wallingford	42.00	35.54
24558	H. G. Oats and Top Dressing	Suffield. Southington, Cromwell	44.50	37.86
24588	H. G. Soluble Tobacco Manure	Suffield, Southington, Glastonbury	44.25	38.38
24566	H. G. Soluble Tobacco and Potato	Suffield, Burnside, Somerville	40.00	33.73
24799	H. G. Tobacco Grower	Suffield, Rockfall	37.50	31.52
24755	Tobacco Starter	Wapping, Somerville	36.00	22.97
	Sanderson Fertilizer & Chemical Co., New Haven, Conn.			
24513	Atlantic Coast Bone, Fish and Potash	Guilford, East Hampton, Plainville	25.75	20.27
24676	Kelsey's Bone, Fish and Potash	Granby	29.00	25.44
24721	Sanderson's Corn Superphosphate	East Hampton, Torrington	28.00	15.98
24568	" Formula A	New Haven, Guilford	35.00	24.83
24722	" " B for Tobacco	Green's Farms, Simsbury	33.50	25.79
24480	" Potato Manure	New Haven, Danbury, East Hampton	30.25	19.12
24514	" Special with 10% Potash	New Haven, East Hampton, Plainville	36.25	23.77
24595	" Top Dressing for Grass and Grain	New Haven, Danbury	38.50	30.16
	The C. M. Shay Fertilizer Co., Groton, Conn.			
24442	*Corn Fertilizer	Norwich, Guilford	29.50	21.29
24596	" "	Putnam, Norwich	29.50	22.06
24530	Grass and Lawn Fertilizer	Norwich, Leonard's Bridge	36.00	29.23
24441	Potato Manure	Norwich, Guilford	34.00	28.26

* See note page 428

ANALYSES AND VALUATIONS—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
24653	46.0	1.00	----	1.14	2.14	2.0	5.90	5.06	1.46	12.42	10.0	10.96	9.0	5.77	5.77	[illegible]
24587	49.7	1.21	0.10	1.43	2.74	2.5	2.90	5.19	1.61	9.70	8.0	8.09	5.5	8.91	8.91	[illegible]
24617	34.4	2.09	0.26	2.82	5.17	5.0	1.26	7.82	2.20	11.28	10.0	9.08	7.0	1.26	5.86	[illegible]
24707	31.1	1.99	0.28	2.61	4.88	5.0	0.89	7.91	2.60	11.40	10.0	8.80	7.0	0.98	10.87	[illegible]
24655	71.5	1.02	----	1.10	2.12	1.7	1.44	6.96	3.13	11.53	10.0	8.40	8.0	2.35	2.35	[illegible]
24654	44.2	1.07	0.22	1.34	2.63	2.3	5.74	3.73	1.33	10.80	10.0	9.47	8.0	5.96	5.96	[illegible]
24567	50.9	0.89	0.38	2.23	3.50	3.3	2.41	3.08	1.97	7.46	6.0	5.49	4.0	4.07	4.07	[illegible]
24557	33.4	1.52	0.33	2.06	3.91	3.8	4.04	4.09	1.93	10.06	8.0	8.13	6.0	7.36	7.36	[illegible]
24656	18.2	0.31	0.20	2.49	3.00	3.0	0.00	11.93	6.47	18.40	16.0	11.93	----	13.90	13.90	[illegible]
24558	17.5	4.16	0.20	2.39	6.75	6.3	3.00	5.20	2.23	10.43	9.0	8.20	7.0	7.77	7.77	[illegible]
24588	15.3	1.22	0.40	3.26	4.88	5.0	1.20	7.38	1.97	10.55	8.0	8.58	6.0	1.34	12.59	[illegible]
24566	18.6	0.50	0.50	3.07	4.07	3.5	1.30	6.85	2.98	11.13	9.0	8.15	7.0	1.02	10.56	[illegible]
24799	19.0	1.28	0.70	3.27	5.25	5.0	0.19	5.15	2.28	7.62	5.0	5.34	4.0	0.80	7.02	[illegible]
24755	56.7	1.08	0.45	2.23	3.76	3.8	1.87	4.01	2.97	8.85	5.0	5.88	4.0	1.59	3.31	[illegible]
24513	27.0	----	0.46	2.04	2.50	1.7	2.76	3.59	1.22	7.57	6.0	6.35	4.0	0.93	4.94	[illegible]
24676	14.0	----	0.92	3.01	3.93	2.5	1.29	5.53	1.55	8.37	5.0	6.82	4.0	1.10	4.42	[illegible]
24721	75.2	0.79	0.50	0.86	2.15	1.7	1.71	4.95	2.03	8.69	9.0	6.66	7.0	2.47	2.47	[illegible]
24568	41.0	0.90	0.92	1.48	3.30	3.3	2.62	4.35	1.58	8.55	9.0	6.97	6.0	7.79	7.79	[illegible]
24722	29.9	1.09	0.60	1.80	3.49	3.3	4.61	2.57	1.76	8.94	10.0	7.18	6.0	1.25	6.46	[illegible]
24480	58.2	0.16	0.62	1.52	2.30	1.7	3.05	4.28	1.55	8.88	7.0	7.33	5.0	5.55	5.55	[illegible]
24514	52.5	0.30	0.80	1.86	2.96	2.5	3.22	2.86	1.14	7.22	7.0	6.08	5.0	8.42	8.42	[illegible]
24595	27.6	2.36	0.10	1.86	4.32	4.0	6.38	2.81	0.83	10.02	7.0	9.19	7.0	7.68	7.68	[illegible]
24442	38.6	----	0.17	2.67	2.84	3.0	2.96	3.61	2.03	8.60	8.0	6.57	---?	4.37	4.37	[illegible]
24596	33.7	----	0.08	2.94	3.02	3.0	2.78	3.93	1.87	8.58	8.0	6.71	----	4.29	4.29	[illegible]
24530	23.2	0.96	0.20	3.11	4.27	4.0	3.73	4.65	1.05	9.43	10.0	8.38	----	6.57	6.57	[illegible]
24441	20.3	0.86	0.22	3.01	4.09	4.0	3.72	3.99	1.56	9.27	8.0	7.71	----	6.60	6.60	[illegible]

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.
	Sampled by Station Agent:			
	M. L. Shoemaker & Co., Philadelphia, Pa.			
24443	"Swift-Sure" Superphosphate for General Use	Hartford, Glastonbury, Guilford	$36.00	$27.80
24800	"Swift-Sure" Superphosphate for Potatoes	Guilford	37.00	27.51
24801	"Swift-Sure" Guano for Truck, Corn and Onions	Guilford	31.00	21.06
	Swift's Lowell Fertilizer Co., Boston, Mass.			
24803	Swift's Market Garden Manure	Westport	33.00	27.04
24467	" Perfect Tobacco Grower	Ellington, Rockville, Windsor Locks	39.00	25.36
24804	" Potato Grower	Westport	33.00	27.72
24724	" Special Corn and Vegetable Manure	Southport, Kensington	34.00	26.11
24805	Swift's Special Grass Mixture	Rockville	40.00	28.92
24725	" " Potato Fertilizer	Southport, Wallingford, Kensington	32.75	23.67
24806	" Superior Fertilizer with 10% Potash	Rockville	39.00	29.65
24807	Swift's Tobacco Manure	Warehouse Point	45.00	32.19
24378	" Lowell Animal Brand	New Britain, Norwich, Ellington	33.00	20.36
24376	" " Bone Fertilizer	Norwich, Ellington, Rockville	30.00	16.98
24802	" " Dissolved Bone and Potash	Ellington	29.00	18.65
24569	Swift's Lowell Empress Brand	Wallingford, Putnam, Moosup	27.75	13.46
24377	" " Potato Manure	New Britain, Norwich, Rockville	31.00	16.12
24723	" " Potato Phosphate	Ellington, Rockville	35.50	21.74
	*** Tanner & Wilcox, Winsted, Conn.**			
24677	Reliable Potato and Garden Phosphate	Winsted	34.00	27.61
	The Wilcox Fertilizer Co., Mystic, Conn.			
24570	Complete Bone Superphosphate	Mystic, Woodstock, Norwich	29.00	20.69
24444	Fish and Potash	Mystic, Norwich, Guilford	25.50	19.63
24531	Grass Fertilizer	Suffield, Wallingford	38.00	27.88
24726	H. G. Fish and Potash	Norwich, Woodstock	29.00	22.89
24808	*H. G. Tobacco Special	Ellington	35.00	32.06
24481	Potato Fertilizer	Suffield, Mystic, Wallingford	29.00	20.46

* See note, page 428.

Analyses and Valuations—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
24443	29.5	1.15	0.03	1.83	3.01	2.9	8.55	3.98	1.36	13.89	12.0	12.53	9.0	0.57	5.37	4.5
24800	34.5	0.90	0.06	1.88	2.84	2.9	8.15	4.29	1.36	13.80	11.0	12.44	8.0	6.60	6.60	7.0
24801	47.2	0.70	0.05	0.97	1.72	1.7	6.96	3.75	1.38	12.09	10.0	10.71	8.0	5.85	5.85	5.0
24803	22.0	....	0.63	3.17	3.80	4.1	5.12	2.76	0.84	8.72	8.0	7.88	7.0	6.09	6.09	6.0
24467	53.8	0.80	0.07	2.81	3.68	4.1	1.36	4.01	1.24	6.61	5.0	5.37	4.0	0.94	6.55	6.0
24804	19.0	....	0.68	2.67	3.35	3.3	4.65	1.76	0.97	7.38	7.0	6.41	6.0	10.43	10.43	10.0
24724	30.2	....	0.70	2.47	3.17	3.3	6.58	2.96	0.58	10.12	9.0	9.54	8.0	6.44	6.44	7.0
24805	38.3	....	0.65	3.60	4.25	4.1	5.38	2.27	0.88	8.53	8.0	7.65	7.0	6.39	6.39	6.0
24725	38.4	....	0.12	2.20	2.32	2.5	4.02	2.53	0.68	7.23	7.0	6.55	6.0	10.09	10.09	10.0
24806	31.5	....	0.58	2.83	3.41	3.7	5.50	2.71	0.49	8.70	8.0	8.21	7.0	10.76	10.76	10.0
24807	39.8	0.92	0.10	3.28	4.30	4.0	3.56	2.90	0.96	7.42	7.0	6.46	6.0	0.70	10.01	10.0
24378	62.1	....	0.44	1.90	2.34	2.5	6.00	2.35	0.95	9.30	10.0	8.35	8.0	4.36	4.36	4.0
24376	76.7	....	0.40	1.34	1.74	1.6	6.22	2.00	0.90	9.12	9.0	8.22	8.0	3.27	3.27	3.0
24802	55.5	....	0.10	1.84	1.94	1.6	6.22	3.62	1.69	11.53	10.0	9.84	9.0	2.11	2.11	2.0
24569	106.2	....	0.06	1.18	1.24	1.3	5.00	2.48	0.78	8.26	8.0	7.48	7.0	2.07	2.07	2.0
24377	92.3	....	0.34	1.31	1.65	1.6	5.30	1.90	0.46	7.66	8.0	7.20	7.0	3.91	3.91	4.0
24723	63.3	....	0.38	1.90	2.28	2.5	5.96	2.63	0.63	9.22	9.0	8.59	8.0	6.13	6.13	6.0
24677	23.1	0.99	0.08	1.86	2.93	3.3	3.53	4.77	3.34	11.64	9.3	8.30	8.0	9.88	9.88	9.0
24570	40.2	0.64	0.20	1.44	2.28	2.1	3.99	5.83	1.68	11.50	9.0	9.82	8.0	3.91	3.91	3.0
24444	29.9	0.05	0.36	2.27	2.68	2.5	2.82	3.20	1.44	7.46	6.0	6.02	5.0	4.19	4.19	3.0
24531	36.3	1.46	1.08	1.83	4.37	4.1	4.20	3.37	1.21	8.78	7.0	7.57	6.0	3.69	6.02	5.0
24726	26.7	....	0.40	2.96	3.36	3.3	3.67	2.23	0.59	6.49	6.0	5.90	5.0	•5.24	5.24	4.0
24808	9.2	0.80	0.06	2.76	3.62	3.3	0.00	2.76	0.26	3.02	7.0	2.76	5.0	0.82	16.08	7.0
24481	41.7	0.53	0.18	1.69	2.40	2.1	2.50	4.31	2.02	8.83	7.0	6.81	6.0	1.86	5.19	4.5

NITROGENOUS SUPERPHOSPHATES.

Station Number.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation per ton.
	Sampled by Station Agent: **The Wilcox Fertilizer Co.** *(Continued).*			
24727	Potato, Onion and Vegetable Phosphate	Guilford, Woodstock	$34.50	$24.47
24728	Special Superphosphate	Mystic, Wallingford, So. Meriden	25.75	14.99
	S. D. Woodruff & Sons, Orange, Conn.			
24240	Home Mixture	Orange	30.00	28.56
	Sampled by Purchasers and others:			
24756	Bowker's Stockbridge Complete Manure for Corn and All Grain Crops	*Guilford:* J. B. Hubbard	40.00	27.29
24590	E. D. Chittenden's Mixture for Grass	*Wapping:* W. Hills	33.00	31.00
24589	" " Potato and Grain	" "	27.50	24.92
24887	Clay's Fertilizer	*Groton:* T. W. Head	140.00	23.20
24592	Conn. Valley Orchard Co. High Grade Fertilizer	*Deep River:* G. W. Spicer	28.00	22.21
24532	Cooper's Sterling Brand for Potatoes	*So. Wethersfield:* T. Griswold & Co.	24.00	21.69
24678	Frisbie's Keeney's Mixture	*Somerville:* M. Keeney	38.50	37.16
24476	Mapes' Tobacco Ash Constituents	*West Suffield:* Bissell-Graves	35.00	27.32
24477	" " " "	" " " "	35.00	28.33
24303	New England Corn Fertilizer	*Newtown:* L. Busker	32.00	15.74
24304	" " Potato Fertilizer	" "	32.00	16.52
24445	Olds & Whipple's Complete Tobacco Fertilizer	*Burnside:* J. M. Hickey	36.00	30.11
24231	Rogers' H. G. Tobacco Grower	*Granby:* E. M. Griffin	37.50	31.37
24642	Sanderson's Special (Formula A with 10% Potash)	*Shelton:* O. G. Beard	38.00	32.40
24619	Sanderson's Special No. 1	*New Haven:* J. I. Webb	29.50	28.74
24620	" " " 2	" " " "	29.50	29.10
24331	Tanner & Wilcox's Reliable Potato and Garden Phosphate	*Winsted:* Manufacturer	34.00	28.30

* 4.45 per cent. potash as sulphate, 8.75 per cent. as carbonate.
† 4.39 " " " " " 9.39 " " " "
‡ 1.39 " " " " " 3.89 " " " "

Analyses and Valuations—*Concluded.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
24727	41.0	0.96	0.77	1.41	3.14	3.3	5.97	2.24	0.54	8.75	8.0	8.21	7.0	4.21	6.55	6.0
24728	71.8	....	0.15	1.06	1.21	1.0	2.86	5.86	2.03	10.75	9.0	8.72	8.0	2.59	2.59	1.5
24240	5.0	1.06	0.52	2.08	3.66	3.3	4.68	3.52	1.22	9.42	...	8.20	8.0	9.02	9.02	8.0
24756	46.6	....	2.44	0.82	3.26	3.3	7.58	2.82	1.25	11.65	11.0	10.40	10.0	7.79	7.79	7.0
24590	6.5	....	3.20	0.67	3.87	..	4.16	5.86	2.30	12.32	....	10.02	....	10.27	10.27	....
24589	10.4	0.11	1.64	1.07	2.82	3.3	7.08	1.85	2.38	11.31	10.0	8.93	8.0	7.34	7.34	6.0
24887	....	....	2.33	2.89	5.22	..	0.20	1.04	7.46	8.70	....	1.24	....	0.22	0.22	....
24592	26.1	1.53	0.10	1.20	2.83	2.5	7.34	1.38	0.67	9.39	10.0	8.72	9.0	4.95	4.95	4.0
24532	10.7	0.62	0.40	0.94	1.96	1.6	1.70	4.69	2.82	9.21	10.0	6.39	8.0	9.72	9.72	8.0
24678	3.6	4.64	0.35	0.40	5.39	..	0.46	4.87	0.43	5.76	....	5.33	....	2.26	15.45	....
24476	28.1	0.10	0.00	0.75	0.85	0.5	0.02	3.70	2.93	6.65	5.7	3.72	....	1.65	*14.85	15.0
24477	23.5	....	0.02	0.78	0.80	0.5	0.02	3.65	3.11	6.78	5.7	3.67	....	1.83	†15.61	15.0
24303	103.3	....	0.34	1.18	1.52	..	6.08	1.94	1.06	9.08	...	8.02	....	2.93	2.93	....
24304	93.7	....	0.20	1.42	1.62	1.6	5.22	2.13	0.68	8.03	8.0	7.35	7.0	4.15	4.15	4.0
24445	19.6	0.50	0.10	4.19	4.79	4.5	0.09	3.61	0.65	4.35	3.5	3.70	3.0	0.69	‡5.97	5.5
24231	19.5	1.18	0.18	3.40	4.76	5.0	0.98	5.48	2.89	9.35	5.0	6.46	4.0	1.21	7.17	6.0
24642	17.3	2.46	0.72	1.27	4.45	4.0	6.23	2.03	2.24	10.50	10.0	8.26	8.0	0.43	9.08	10.0
24619	2.6	1.65	0.08	2.63	4.36	3.3	4.13	2.33	1.37	7.83	....	6.46	6.0	7.70	7.70	6.0
24620	1.4	1.65	0.10	2.69	4.44	3.3	3.87	2.64	1.36	7.87	....	6.51	6.0	7.78	7.78	6.0
24331	20.1	1.00	0.13	2.20	3.33	3.3	2.89	5.32	2.96	11.17	9.3	8.21	....	9.22	9.22	9.0

and of both nitrogen and potash in their Connecticut Valley Tobacco Grower, **24786**, page 418, requested that other samples be drawn. An attempt was made to comply with the request, but other samples could not at that time be found.

The C. M. Shay Co. protested that analysis **24442**, p. 422, which showed a deficiency of 0.16 per cent. of nitrogen, did not represent the quality of their Corn Fertilizer, and requested that another sample be drawn and examined. This was done, and the analysis, **24596**, shows 0.02 per cent. above guaranty. In both analyses the percentages of potash and phosphoric acid were well above guaranty, and under such conditions a deficiency of 0.16 per cent. of nitrogen is not significant.

Tanner & Wilcox advise that the shortage of nitrogen shown in the sample **24677**, p. 424, of their Reliable Potato and Garden Phosphate, was due to a mistake in the quality of some nitrogenous material sold them, which was ordered as ten per cent. goods, whereas eight per cent. goods were delivered. The shortage was made good in subsequent mixtures.

The sample **24808**, Wilcox High Grade Tobacco Special, p. 424, does not at all represent the quality of this brand. The manufacturers advise that a mistake was discovered in the mixing and all the shipments were ordered returned and the proper correction made, except in the one from which our sample was drawn, which was overlooked. In this mixture the buyer receives a larger money equivalent in plant food than in the regular formula, so that the money loss comes on the manufacturer.

Guaranties.

Of the 264 analyses of nitrogenous superphosphates sampled by the Station Agent, 85 or nearly one-third of the number failed to meet their guaranties in one or more particulars. In many cases the difference was small and in most cases a deficiency of one ingredient was made good in money equivalent by other ingredients which exceeded the guaranty.

In the following brands, however, this deficiency was not thus balanced by excess of other ingredients: Atlantic High-Grade Truck and Potato Special, Germofert Patented Potato Manure, Germofert Special Cotton Manure, Manchester's Special, Mapes' Top Dressing, and Niantic Market Garden Manure.

Cost.

An effort is made to get a statement of cash retail price from each dealer from whom a sample is taken and these statements are

in all cases submitted to the manufacturer for criticism. In general an average of the quoted prices forms the basis of comparison between cost and valuation.

Valuation.

The method and meaning of valuation is explained on page 40.

The schedule of trade-values is given on page 397. The *organic nitrogen in mixed fertilizers is reckoned at the price of* nitrogen in raw material of the best quality, 20 cents per pound.

Citrate-insoluble phosphoric acid is rated at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in those cases where carbonate of potash has been used in the mixture. In these cases the method is followed which is described on page 404.

In most cases the valuation of the ingredients in superphosphates falls considerably below the retail price. The difference between the two figures represents the manufacturer's charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investments, bad debts, and, finally, profits.

To obtain the Valuation of a Fertilizer, multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. The several products give the values per ton of the several ingredients and their sum is the total valuation per ton.

Percentage Difference.

Percentage Difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer and furnishes the best means we have for expressing the *comparative* commercial (but not *agricultural*) value of the different brands.

This information helps the purchaser to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials. In some cases the prices quoted by dealers differ very widely, in extreme cases by $5.00 per ton.

As the percentage difference varies with the price, any uncertainty or misstatement as to price makes a corresponding uncertainty and inaccuracy in the percentage difference.

The average cost per ton of two hundred and fifty-eight nitrogenous superphosphates, of which the costs and valuations are given in the table, is $34.31, the average valuation $23.36, and the percentage difference 46.9.

The average composition and cost of nitrogenous superphosphates for the last three years have been as follows:

	Nitrogen.	Total Phosphoric Acid.	"Available" Phosphoric Acid.	Potash.	Cost per Ton.	Percentage Difference.
1908.........	2.91	9.55	7.97	5.63	$34.13	38.5
1909.........	2.93	9.52	8.09	5.78	33.96	52.1
1910.........	2.98	9.28	7.83	5.88	34.36	46.9

2. *Sampled by Purchasers and Others.*

In the table pages 426 to 427 are given the analyses of seventeen samples drawn by others than the Station Agent. The Station assumes the responsibility only for the accuracy of analysis of these samples, not for the accuracy of the sampling. The sender, however, provides a certificate, stating that the sample was drawn properly in substantial accordance with the Station's directions.

THE SOLUBILITY OF ORGANIC FORMS OF NITROGEN IN FERTILIZERS.

By John Phillips Street.

Most of the nitrogenous superphosphates sold in this State contain nitrogen in three forms which differ both in their commercial and agricultural value.

First: About two-thirds of these fertilizers contain nitrogen as nitrates, which ranges in amount from a trace to more than 3.00 per cent.; the average for those containing nitrate being 0.92 and for the whole number 0.60 per cent.

Second: With only three exceptions, all contain nitrogen in form of ammonia salts or yield ammonia on distillation with magnesia. Three-fourths of the number contain one per cent. or less. The average amount of ammonia is 0.76 per cent.

Third: Nitrogen in organic forms, ranging from 0.24 to 4.37 per cent. with an average of 1.62 per cent.

Recognizing the wide range of percentages given above, we may say, with sufficient exactness for the purpose of this discussion, that the nitrogenous superphosphates taken together, as a composite, contain:

Nitrogen in form of nitrates	0.60	per cent.
" " " ammonia	0.76	"
" " organic forms	1.62	"
Total nitrogen	2.98	"

The nitrogen in form of nitrate, generally nitrate of soda but sometimes nitrate of potash, is always the same in its form of combination, it is perfectly soluble in water and its fertilizing effect, compared with other forms of nitrogen, is fairly well known.

The larger part of the nitrogen in form of ammonia which is found in these fertilizers comes from sulphate of ammonia added in the factory mixture. It comes in part, however, from other sources. For example, in the analyses of fish small amounts of ammonia are always obtained by the analytical method used. There is no doubt that this comes from other things than added sulphate of ammonia. While drying, fish decomposes to some extent, yielding ammonia as one of the decomposition products. It is quite likely, too, that ammonia is formed during the process of determination by the decomposition of amines formed in decaying fish, which readily break up with formation of ammonia. The agricultural value of sulphate of ammonia is well known. The value of nitrogen in other matters which yield ammonia on distillation with magnesia has not been determined.

But organic nitrogenous matters are most complex and various and their comparative fertilizing value is not known except in the most general way. They may come from the greatest variety of sources: some are freely soluble in water, others totally insoluble; some quickly decompose and yield their nitrogen to crops, while others are almost inert. It is not possible, in most cases, to certainly identify these organic matters, such as blood, meat, peat, treated leather, bat guano, hoof meal, etc., either by the eye alone or with the microscope and chemical reagents. Were this possible, some crude estimate might be made of the farm value of the mixtures containing them.

Yet some method of estimation is urgently needed. More than half of the nitrogen in the average mixed fertilizer is in organic forms and for this nitrogen the buyer pays more than twenty cents a pound with only little knowledge of its real farm value.

The urgency is becoming greater. It is difficult to meet the ever-increasing demand for fertilizer-nitrogen at prices that the farmer can pay; and various processes have been and are being tried to convert the nitrogen of comparatively inert "ammoniates" such as leather, wool waste, hair and other manufacturing waste into soluble and available forms. If this can be done, it will vastly increase the supply of fertilizer-nitrogen at prices which the farmer can pay. In principle, there is nothing wrong in the plan and theoretically it is possible. It is just as legitimate as the conversion of comparatively inert ground phosphate into quickly available acid phosphate and if it succeeds it will be an even greater help to agriculture.

It is quite likely that from now on mixed fertilizers will contain more or less nitrogenous matter derived from things like leather, hair, etc., agriculturally inert in their crude state, but which have been treated with the object of making them agriculturally valuable. Whether this object has been attained, it is of the first importance to know. The manufacturers themselves are not in position to prove the point.

These considerations make it desirable for the stations to coöperate in devising some method to determine at least in approximate fashion the probable availability of that part of the nitrogen of commercial fertilizers which is in organic forms.

The work to be described here is chiefly preliminary to a study of the actual availability to crops of water-soluble and permanganate-soluble forms of nitrogen and to devising, if possible, a laboratory method which shall be useful in determining the agricultural value of organic forms of nitrogen. The water- and permanganate-solubility of nitrogen has been determined in one hundred and seventeen samples of organic nitrogenous matters known to be used in fertilizer mixtures. These samples include thirty-five kinds of material of all grades of agricultural value. The results appear in the following table on pages 438 to 440.

Ammonia.

We have reckoned all the nitrogen yielded by boiling the fertilizer in the usual way with magnesium oxide, as from ammonia.

The high percentages obtained in many cases emphasize the suggestion made on an earlier page, that a considerable portion of this ammonia comes not from ammonia salts but rather from partial putrefaction of the material, or from organic forms that yield ammonia when boiled with magnesia. The agricultural value of these forms has yet to be established.

Materials like blood, hoof meal, cotton seed meal, castor pomace and bone yield but little ammonia, at most only a few tenths of one per cent. The samples of fish yield from 0.12 to 1.40 per cent. and tankage shows about the same variation. "Fillerine" and beet root manures, both generally considered to contain relatively inert forms of nitrogen, have 0.90 and 2.02 per cent. respectively of ammonia. Two samples of alleged tankage examined in 1909 contained 2.38 and 2.29 per cent. of ammonia, and, considering their analyses and appearance, are believed to be forms of beet root manure. The high ammonia content of these materials which are generally assumed to be of inferior value, raises the question, whether their agricultural value is underestimated, or whether the availability and value of all the ammonia set free by magnesium oxide is overestimated. The percentages of nitrogen as ammonia are given in the third column of the table.

Water-Soluble Organic Nitrogen. *

The percentages of water-soluble nitrogen, given in the fourth column of the table, are specially interesting. High-grade dried blood, hide and skin meal, tartar pomace, "fillerine" and peat have only traces. Certain other materials contain large amounts. Ammonite, for instance, contains 6.73 per cent. while a number of samples of fish and tankage have from 2.00 to nearly 4.00 per cent., a sample of bone meal 2.36 per cent., and "solubilized organic nitrogen" and "azote," both of them forms of treated leather, contain respectively 1.45 and 2.02 per cent.

These figures suggest a very important problem; namely, the value of the water-soluble organic nitrogen. If it is readily

* Water-soluble organic nitrogen was determined by extracting one gram of the sample with water at room temperature. The water-soluble organic nitrogen is calculated by subtracting the nitrogen of the residue from the total organic nitrogen in the substance.

available to crops, whatever the source from which it comes, it is clear that certain fertilizer materials, hitherto classed as low grade, are undervalued. On the other hand, if this water-soluble nitrogen is not in all cases readily available, the value of the wet-mixing process for rendering inert forms of nitrogen soluble and available is questionable.

Insoluble Organic Nitrogen.*

The amount of organic nitrogen which is insoluble in water and permanganate solution is given in the fifth column of the table, and in the sixth the percentage insoluble in both water and permanganate solution.

It appears that the nitrogen in all of those materials which are generally regarded as high-grade, is highly soluble in permanganate, while that of the others, like garbage tankage and peat, is very much less soluble. The following table gives the average solubilities of some of the typical organic forms.

Permanganate Solubility of the Organic Nitrogen which is Insoluble in Water.

Dried blood	96 per cent.
Hoof meal	95
Cotton seed meal	93
Ground bone	93
Dried fish	91
Tankage	90

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*NEUTRAL PERMANGANATE METHOD.

Weigh a quantity of the fertilizer, equivalent to 45 mgms. of water-insoluble organic nitrogen, on a moistened 11 cm. filter paper, and wash with successive portions of water at room temperature until the filtrate amounts to 250 cc. Transfer insoluble residue with 25 cc. of tepid water to a 300 cc. low-form Griffin beaker, and add 100 cc. of 2 per cent. permanganate of potash solution. Digest in a steam or hot-water bath for thirty minutes at the temperature of boiling water, covering the beaker with a watch glass and setting well down into the bath so that the level of the liquid in the beaker is below that of the bath. Stir twice at intervals of ten minutes. At the end of the digestion, remove from the bath, add 100 cc. of cold water and filter through a heavy 15 cm. folded filter. Wash with cold water, small quantities at a time, until total filtrate amounts to about 400 cc. Determine nitrogen in residue and filter, correcting for the nitrogen of the filter.

Castor pomace	88
Tartar pomace	54
Garbage tankage	50
Sheep manure	48
Peat	42
Tobacco stems	39
Mora meal	34

Ranging in solubility between castor pomace and tartar pomace are the greater number of articles prepared for use in fertilizers from inert forms by some treatment designed to make them more available. Such are the various treated leather preparations, "fillerine" and beet root manure. Inasmuch as all the materials which experience shows to be quickly available give permanganate solubilities of 85 or over, a solubility much below this minimum suggests, but does not prove, relative inferiority as a source of nitrogen for feeding a growing crop.

The fifty samples of raw materials examined this year in our regular fertilizer inspection were also tested for permanganate solubility. The solubility of thirteen of the tankages ranged from 83 to 94 per cent., while one was only 72 per cent.; that of eighteen samples of fish ranged from 87 to 94; of dried blood from 94 to 97; of castor pomace from 87 to 92; of the single samples of cotton seed and hoof meals, each 96; while the permanganate solubility of garbage tankage, treated leather, tobacco stems, fish and peat and "dissolved animal matter" (leather) were 67, 79, 45, 46, and 17 respectively.

The only solubilities which appear erratic are those of dissolved bone and hair manure. Thus two samples of dissolved bone had permanganate solubilities of 71 and 69 respectively, figures which are so low as to make us question whether the two articles are true to their names. The solubility of hair manure (92 per cent) is much higher than would have been expected, but the particular sample tested was a very fine, soft hair which rapidly disintegrated when rubbed between the fingers. A sample of coarse, more resistant hair was not at our disposal, so that the figure given for hair must not be considered typical for that material, but only as representing this particular sample. The data discussed above indicate that the neutral permanganate method may offer a means of determining the approximate rela-

tive value of the organic nitrogen found in commercial fertilizers. At any rate it seems sufficiently promising to warrant pot and perhaps field experiments to determine how far the differences in solubility noted above correspond to differences in actual fertilizing value and how far the approximate relative value of organic nitrogen may be determined by a laboratory method.

Permanganate Solubility of Organic Nitrogen in Mixed Fertilizers.

The solubility of the organic nitrogen of all the mixed fertilizers analyzed in 1910 has been determined by the two reagents: water and neutral solution of potassium permanganate. Only a brief summary of results can here be given. On the average about 23.5 per cent. of the organic nitrogen was soluble in cold water, 63 per cent. was soluble in neutral permanganate and 13.5 per cent. was insoluble in both. In one fertilizer as much as 72 per cent. of the organic nitrogen was water-soluble.

Only a very small percentage of nitrogen insoluble in the above reagents was found in the tobacco specials, the average in thirty-three brands being 9 per cent. and only seven of them having more than that percentage.

If the quality of a fertilizer were to be judged by this method, it would not be fair to consider the actual amount of insoluble organic nitrogen apart from its relation to the total nitrogen. The nitrogen of certain high-grade fertilizers consists almost entirely of soluble inorganic forms, nitrates and ammonia salts, and the total organic nitrogen consists of only a few tenths of one per cent. Now, even granting that this organic nitrogen exists in an inferior form and shows a low permanganate solubility, say 40 to 50 per cent., the smallness of the amount of organic, compared to total, nitrogen gives these figures but little significance in this class of samples. In one sample, for instance, 42 per cent. of the organic nitrogen was insoluble in water or permanganate, yet it amounted to only 0.25 per cent. of actual nitrogen and was only about one-twentieth of the total nitrogen which showed a solubility of 94 per cent.

The following statement shows the range of the solubilities of the *organic* nitrogen in the 250 mixed fertilizers examined.

Number of Brands.	Solubility of Organic Nitrogen in Water and Permanganate of Potash.
96	over 90
50	80 to 89
66	70 79
30	60 69
5	50 59
3	under 50

The relation of permanganate solubility to the amount of total nitrogen present is shown in the following table:

No. of Brands.	Per cent. total Nitrogen.		Permanganate Solubility of Water-insoluble Organic Nitrogen.		
3	under	1.00	56	to 60,	average 58
16	1.01	to 1.50	50	85	65
32	1.51	2.00	46	91	71
49	2.01	2.50	48	93	74
43	2.51	3.00	51	92	73
65	3.01	4.00	56	98	81
32	4.01	5.00	37	97	87
8	5.01	6.00	71	94	86
2	6.01	7.00	92	94	93
2	over	8.00	83	89	86

While there are a few individual exceptions, the "high-grade" fertilizers, those that contain most nitrogen, have a higher nitrogen solubility than the "low-grade" goods.

An ocular examination of 48 of the mixed fertilizers showed with reasonable degree of certainty the nature of their organic nitrogen. It is interesting to note how closely their solubilities, shown in the table below, agree with those given for the corresponding raw materials in the table on pages 438-440.

Fish and bone	89–98,	average 94	Cotton seed meal	88–92,	average 90
Fish	86–97,	91	Tankage	85–92,	89
Castor pomace	94–96,	95	Tankage (?)	65,	65
Blood and bone	89–96,	93	Peruvian guano	89,	89
Tankage & bone	89–94,	92	Sheep manure	50–56,	52
Bone	82–96,	90	Fish and peat	46,	46

Material.	Per cent. of Nitrogen. Total.	As Ammonia.	As Water-soluble Organic.	As Permanganate-soluble Organic.	As Insoluble Organic.	Solubility of Organic Nitrogen. Total.	Water-insoluble Organic.
Dried Blood	14.06	0.10	0.20	13.35	0.41	97	97
"	13.04	0.04	0.00	12.61	0.39	97	97
"	13.32	0.06	0.00	12.73	0.53	96	96
"	8.90	0.06	0.88	7.64	0.32	96	96
"	10.35	0.08	0.21	9.46	0.60	94	94
"	10.34	0.34	0.60	8.84	0.56	94	94
Average	**11.67**	**0.11**	**0.32**	**10.77**	**0.47**	**96**	**96**
Hoof Meal	14.83	0.38	1.25	12.54	0.66	95	95
"	15.16	0.32	1.12	13.03	0.69	95	95
Average	**15.00**	**0.35**	**1.19**	**12.78**	**0.68**	**95**	**95**
Azotine	13.00	0.07	1.73	10.64	0.56	96	95
Cotton Seed Meal	7.09	0.11	0.63	6.10	0.25	96	96
"	8.22	0.10	0.62	7.05	0.45	94	94
"	6.03	0.08	0.61	4.97	0.37	94	93
"	6.80	0.06	0.74	5.52	0.48	93	92
"	7.00	0.06	0.82	5.57	0.55	92	91
Average	**7.03**	**0.08**	**0.68**	**5.85**	**0.42**	**94**	**93**
Bone Knuckle	4.09	0.01	0.22	3.74	0.12	97	97
Bone Dust	2.02	0.00	0.78	1.14	0.10	95	92
Bone Meal	5.40	0.00	2.36	2.77	0.27	95	91
Average	**3.84**	**0.00**	**1.12**	**2.56**	**0.16**	**96**	**93**
Hair Manure	8.06	0.80	1.14	5.65	0.47	94	92*
Dried Fish	9.33	0.40	0.71	7.73	0.49	95	94
"	8.82	0.15	0.71	7.48	0.48	94	94
"	8.30	0.12	0.96	6.71	0.51	94	93
"	9.46	0.18	2.88	5.95	0.45	95	93
"	6.69	0.24	1.99	4.15	0.31	95	93
"	8.68	0.61	2.10	5.49	0.48	94	92
"	8.32	0.47	2.81	4.64	0.40	95	92
"	8.64	0.52	0.92	6.62	0.58	93	92
"	7.75	0.66	1.93	4.70	0.46	94	91
"	8.44	0.94	1.54	5.42	0.54	93	91
"	8.12	0.40	1.68	5.50	0.54	93	91
"	8.13	0.44	2.71	4.53	0.45	94	91
"	7.94	0.84	1.82	4.80	0.48	93	91
"	8.03	1.40	1.49	4.63	0.51	92	90
"	8.08	0.89	1.83	4.77	0.59	92	89
"	7.79	0.88	1.74	4.60	0.57	92	89
"	7.59	0.68	1.97	4.40	0.54	92	89
"	7.68	0.78	1.80	4.49	0.61	91	88
"	8.20	1.34	1.48	4.73	0.65	90	88
"	8.06	1.33	1.64	4.43	0.66	90	87
"	5.80	0.90	1.20	3.21	0.49	90	87
"	4.82	0.65	1.19	2.56	0.42	90	86
Average	**7.94**	**0.67**	**1.69**	**5.07**	**0.51**	**93**	**91**

* See note, page 435.

Material.	Per cent. of Nitrogen. Total.	As Ammonia.	As Water-soluble Organic.	As Permanganate-soluble Organic.	As Insoluble Organic.	Solubility of Organic Nitrogen. Total.	Water-insoluble Organic.
Tankage	7.68	0.10	0.54	6.69	0.35	95	95
"	6.45	0.06	0.53	5.51	0.35	95	94
"	6.66	0.08	0.58	5.64	0.36	95	94
"	4.74	0.18	0.86	3.44	0.26	94	93
"	5.35	0.20	0.93	3.92	0.30	94	93
"	4.62	0.23	0.87	3.27	0.25	94	93
"	5.78	0.15	1.31	4.02	0.30	95	93
"	7.40	0.14	2.44	4.48	0.34	95	93
"	6.00	0.70	0.74	4.24	0.32	94	93
"	5.74	0.15	1.55	3.76	0.28	95	93
"	5.24	0.27	0.77	3.91	0.29	94	93
"	5.48	0.28	0.92	3.94	0.34	93	92
"	5.04	0.18	1.11	3.45	0.30	94	92
"	5.60	0.02	2.50	2.80	0.28	95	91
"	4.88	0.13	1.59	2.88	0.28	94	91
"	6.36	0.10	2.78	3.17	0.31	95	91
"	6.77	0.76	1.31	4.28	0.42	93	91
"	5.74	0.51	1.35	3.49	0.39	93	90
"	5.39	0.60	1.13	3.29	0.37	92	90
"	7.55	1.32	1.51	4.25	0.47	92	90
"	5.84	0.40	1.34	3.65	0.45	92	89
"	7.33	0.36	3.69	2.85	0.43	94	87
"	7.41	0.19	3.18	3.47	0.57	92	86
"	6.04	0.14	1.81	3.48	0.61	90	85
"	4.10	0.08	2.02	1.70	0.30	93	85
"	5.30	0.15	2.63	2.09	0.43	92	83
"	4.12	0.08	2.19	1.53	0.32	92	83
"	3.60	0.13	1.37	1.74	0.36	90	83
"	5.87	0.09	0.45	3.84	1.49	74	72
Average	**5.80**	**0.27**	**1.52**	**3.61**	**0.40**	**93**	**90**
Tankage (alleged)	5.62	2.38	0.62	1.65	0.97	70	63
" "	5.52	2.29	0.67	1.61	0.95	71	63
Average	**5.57**	**2.33**	**0.65**	**1.63**	**0.96**	**70**	**63**
Ammonite	13.66	0.05	6.73	6.12	0.76	94	89
Castor Pomace	6.22	0.06	0.76	4.97	0.43	93	92
"	6.08	0.00	0.56	5.08	0.44	93	92
"	5.34	0.06	0.98	3.83	0.47	91	89
"	4.96	0.06	0.56	3.86	0.48	90	89
"	4.82	0.03	0.81	3.50	0.48	90	88
"	4.90	0.00	0.64	3.71	0.55	89	87
"	4.65	0.01	0.86	3.29	0.49	89	87
"	5.02	0.00	0.53	3.91	0.58	88	87
"	5.18	0.48	0.42	3.38	0.90	81	79
Average	**5.24**	**0.08**	**0.68**	**3.95**	**0.53**	**90**	**88**
Peruvian Guano	2.65	[1]0.42	0.24	1.39	0.17	91	89
"	8.15	3.12	1.97	2.66	0.40	92	87
Average	**5.40**	**[2]1.77**	**1.11**	**2.02**	**0.28**	**92**	**88**

[1] Contains 0.43 nitrates. [2] Contains 0.22 nitrates.

Material.	Total.	As Ammonia.	As Water-soluble Organic.	As Permanganate-soluble Organic.	As Insoluble Organic.	Nitrogen. Total.	Water-insoluble Organic.
Tygert Tankage	9.48	0.14	0.90	7.43	1.01	89	88
Sewage Waste	4.20	0.04	0.28	3.41	0.47	89	88
Nitrogenous Material	8.84	0.17	0.55	6.58	1.54	82	81
Treated Leather	6.35	0.36	0.45	4.38	1.16	81	79
Cocoon Dust	9.20	0.05	1.19	6.21	1.75	81	78
Hide and Skin Meal	8.06	0.12	0.12	5.87	1.95	75	75
Dissolved Bone	3.26	0.68	1.03	1.10	0.45	83	71*
Acidulated Bone	3.40	0.41	0.42	1.77	0.80	73	69
Fillerine	4.80	0.90	0.00	2.69	1.21	69	69
Solubilized Organic Nitrogen	6.47	0.16	1.45	3.16	1.70	73	65
Beet Root Manure	5.75	2.02	0.41	2.09	1.23	67	63
Azote	7.18	0.30	2.02	2.87	1.99	71	59
Tartar Pomace	3.99	0.48	0.03	1.88	1.60	54	54
Garbage Tankage	2.92	0.10	0.10	1.82	0.90	68	67
"	2.51	0.03	0.52	1.00	0.96	61	51
"	2.45	0.07	0.52	0.87	0.99	58	47
"	2.76	0.09	0.29	1.02	1.36	49	43
"	2.07	0.04	0.55	0.61	0.87	57	41
Average	**2.54**	**0.07**	**0.40**	**1.06**	**1.01**	**59**	**50**
Sheep Manure	2.20	0.25	0.43	0.85	0.67	66	56
"	2.35	0.23	0.44	0.86	0.82	61	51
"	2.50	0.49	0.39	0.81	0.81	60	50
"	2.58	[2]0.37	0.41	0.77	0.95	55	45
"	2.50	0.52	0.25	0.67	1.06	46	39
Average	**2.42**	**0.39**	**0.38**	**0.79**	**0.86**	**58**	**48**
Peat	2.80	0.02	0.02	1.38	1.38	50	50
"	2.81	0.10	0.01	1.24	1.46	46	46
"	2.92	0.08	0.00	1.14	1.70	40	40
"	3.04	0.16	0.28	0.78	1.82	37	30
Average	**2.89**	**0.09**	**0.08**	**1.13**	**1.59**	**43**	**42**
Fish and Peat	3.35	....	....	1.17	1.37	..	46
Tobacco Stems	2.43	[3]0.34	0.52	0.44	0.54	64	45
"	2.42	[4]0.10	0.49	0.60	0.84	56	42
"	2.77	[5]0.28	0.53	0.40	0.70	57	36
"	2.40	[6]0.37	0.55	0.30	0.64	57	32
Average	**2.51**	**[8]0.27**	**0.52**	**0.44**	**0.68**	**59**	**39**
Mora Meal	3.02	0.02	0.24	0.94	1.82	39	34
Dissolved Animal Matter	1.48	....	....	0.08	0.37	..	17

[2] Contains 0.08 nitrates. [3] Contains 0.59 nitrates. [4] Contains 0.30 nitrates

VEGETATION TESTS.

A series of tests was conducted, in which rye was grown in 8 inch flower pots in the greenhouse by the usual methods of experiment. The yields from tankage, cotton seed meal, dried fish, bone, hoof meal, nitrate of soda, calcium nitrate, and calcium cyanide, showed so little agreement among the individual pots under the same kind of fertilization, that no consideration is given them here. However, where nitrogen was supplied in these high-grade forms, the yields both of dry matter and nitrogen were in every case much larger than where the pots received the same amounts of nitrogen in the other forms named below, and these latter yields were very uniform. The yields from dried blood showed good agreement with each other and are used as the basis of comparison. The organic materials were applied in quantities equivalent to 0.15 and 0.25 gm. of actual nitrogen.

The average yields of dry matter and per cents of the fertilizer nitrogen found in the crops are shown below:

	Added fertilizer contained 0.15 gm. N.		Added fertilizer contained 0.25 gm. N.	
	Dry matter of crop, gms.	N. recovered in crop, per cent.	Dry matter of crop, gms.	N. recovered in crop, per cent.
Dried Blood	21.5	47.4	32.9	54.3
Sheep Manure	12.1	20.0	15.2	14.0
Peat	8.9	2.2	9.8	3.1
Fillerine	10.4	9.9	13.1	11.8
Hide and Skin Meal	9.6	8.5	14.2	13.0
Tygert Tankage	14.8	18.5	18.1	18.1
Sol. Organic Nitrogen	11.4	13.3	16.3	11.7
Beet Root Manure	16.1	23.3	20.0	23.0
Azote	13.3	15.3	16.9	14.8
No nitrogen	5.8	....	5.8	....

For the first three weeks of the experiment the differences in growth in the pots were not marked. After that time all the pots fertilized as indicated above, except the blood pots, began to fall behind those fertilized with high-grade ammoniates, and at the end of seven weeks from the beginning of the experiment had practically ceased growing and had turned yellow. The experiment was continued for four months, at the end of which time only small poorly developed heads had been formed in any of the pots showing low nitrogen availability.

By comparing the percentage recovery of the nitrogen with the permanganate solubilities of the same fertilizers given on page 438, it will be seen that all of these materials classed there as inferior, showed a decided inferiority to dried blood in nitrogen assimilation in these vegetation tests.

Peat appears to be almost worthless as a source of nitrogen, while the nitrogen of the other materials is shown to be from about one-fifth to four-tenths as available as that of dried blood.

HOME MIXTURES.

The following table contains analyses of twenty-two samples of fertilizer mixtures sent by those who had prepared and used them. The formulas by which they were prepared are also given, so far as they were reported to the Station.

In some cases there has been some mistake in weighing the

HOME MIXTURES. FORMULAS.

Station No.	Made by or for	Formulas. Pounds per Ton of Mixture.												
		Nitrate of Soda.	Cyanamide.	Dried Blood.	Cotton Seed Meal.	Bone Black Superphosphate.	Acid Phosphate.	Dry Fish.	Tankage.	Fine Ground Bone.	Sulphate of Potash.	Muriate of Potash.	Kainit.	Lime.
24591	C. R. Burr & Co., Manchester	...	...	...	...	...	...	...	800	800	...	400	...	...
24679	H. E. Clark, Middlebury	400	...	300	...	...	...	...	...	900	400†	...	...	...
25174	" "	...	400	300	...	...	...	...	...	900	400†	...	...	...
24398	Connecticut School for Boys, Meriden	500	...	...	...	...	400	...	500	...	...	250	350	...
24399	Connecticut School for Boys, Meriden	100	...	...	...	...	750	...	750	...	200	200	...	...
24757	Dennis Fenn, Milford	200	...	...	...	600	...	...	800	100	...	300	...	...
24758	" "	100	...	100	...	600	...	...	800	200	...	200	...	...
24644	Andrew Kingsbury, Rockville	300	...	...	...	...	800	...	...	600	...	300	...	...
25197	Fred Lyman, Manchester	...	...	...	...	...	834	333	...	416	...	417	...	...
24643	H. B. Pomeroy, Rockville	325	...	...	...	...	1307	...	...	...	...	368	...	...
23987	H. J. Roche, Suffield	...	...	...	1000	...	...	400	...	...	300†	...	...	300
24404	C. R. Treat, Orange	150	...	...	...	...	650	...	850	...	...	350	...	...
24420	G. A. Cleveland, Windsor Locks	...	...	...	...	...	...	...	...	...	...	...	...	...
24680	E. G. Jones, New Canaan	...	...	...	...	...	...	...	...	...	...	...	...	...
24681	" "	...	...	...	...	...	...	...	...	...	...	...	...	...
24817	D. W. Meeker, West Cheshire	...	...	...	...	...	...	...	...	...	...	...	...	...
24421	T. W. Ryan, Stratford	...	...	...	...	...	...	...	...	...	...	...	...	...
24521	S. L. Tuttle, Wallingford, for Corn and General Crops	...	...	...	...	...	...	...	...	...	...	...	...	...
24522	S. L. Tuttle, for Orchards	...	...	...	...	...	...	...	...	...	...	...	...	...
24523	S. L. Tuttle, for Potatoes and Quick Crops	...	...	...	...	...	...	...	...	...	...	...	...	...
24524	S. L. Tuttle, for Oats and Top Dressing	...	...	...	...	...	...	...	...	...	...	...	...	...
24419	Andrew Ure, Highwood	100	...	100	...	...	700	...	800	...	...	300	...	...

* *Does not include cost of mixing or cartage.* † *High grade.*

raw materials or the sample does not fairly represent the mixture, or possibly the raw materials are of quite abnormal composition. Thus in sample **24591**, 400 lbs. of muriate of potash in a ton mixture should yield about 10 per cent. of potash, while the sample showed only 2.2. Again, the bone and tankage used might be expected to yield 11 or 12 per cent. of phosphoric acid, while analysis shows over 17 per cent.

24679, 900 lbs. of ground bone in a ton mixture should yield between 9 and 12 per cent., not 14.5 of phosphoric acid.

The next sample, **25174**, is stated to contain 400 lbs. of cyanamide, or "lime nitrogen," and no nitrate, yet the analysis shows 1.43 per cent. of nitrate nitrogen, equivalent to nearly 200 lbs. of nitrate of soda, in a ton mixture.

These facts emphasize the need of more care in weighing, mixing and sampling. Without such care the analysis is worthless and the time and labor spent on it are wasted.

Analyses and Valuations.

Station No.	Analyses.									Cost and Valuation.	
	Nitrogen as Nitrate.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.	Water-soluble Phosphoric Acid.	Citrate-soluble Phosphoric Acid.	Citrate-insoluble Phosphoric Acid.	Total Phosphoric Acid	Potash.	Cost per ton.	Valuation per ton.
24591	...	0.12	3.81	3.93	2.26	7.73	7.46	17.45	2.22	$31.20	$28.70
24679	2.84	0.12	2.14	5.10	0.24	10.07	4.18	14.49	9.58	36.25	37.39
25174	1.43	0.25	3.50	5.18	0.02	5.69	7.57	13.28	5.10	36.25	31.79
24398	3.62	0.12	1.34	5.08	2.70	2.55	0.72	5.97	8.92	26.91	29.66
24399	0.84	0.12	1.99	2.95	4.79	3.65	1.46	9.90	8.04	23.47	25.77
24757	1.62	0.12	2.67	4.41	0.85	4.97	2.28	8.10	8.76	34.50	29.35
24758	0.72	0.16	2.78	3.66	4.53	4.79	2.35	11.67	7.16	33.00	28.87
24644	2.29	0.04	1.15	3.48	4.20	7.32	2.42	13.94	8.04	28.80	29.50
25197	....	0.14	1.61	1.75	5.03	6.45	4.46	15.94	9.86	29.05	26.74
24643	2.42	0.02	0.05	2.49	7.81	2.07	0.28	10.16	9.73	25.64	25.07
23987	....	0.04	4.72	4.76	0.05	0.82	0.43	1.30	8.01	33.95	27.84
24404	1.17	0.08	2.30	3.55	4.58	2.90	0.77	8.25	8.59	25.75	27.25
24420	0.24	0.05	3.43	3.72	0.07	0.21	0.09	0.37	12.44	....	27.23
24680	2.87	0.05	0.14	3.06	0.02	7.02	2.11	9.15	10.18	32.50	26.49
24681	1.50	0.12	2.50	4.12	2.44	3.24	1.32	7.00	17.28	32.50	37.58
24817	....	0.10	3.30	3.40	1.65	7.01	5.26	13.92	9.50	32.20	30.80
24421	2.80	0.14	2.96	5.90	4.43	3.85	1.65	9.93	5.93	....	34.02
24521	2.76	0.10	1.52	4.38	2.34	5.67	2.77	10.78	10.36	36.00	31.80
24522	2.18	0.05	0.71	2.94	4.37	7.57	1.57	13.51	9.04	34.50	28.28
24523	6.15	0.06	1.30	7.51	1.85	3.93	1.87	7.65	8.11	36.00	37.52
24524	5.22	....	....	5.22	5.31	1.14	0.70	7.15	12.68	35.50	33.45
24419	1.85	0.18	2.80	4.83	4.08	4.58	2.41	11.07	2.24	....	27.89

LIME IN VARIOUS FORMS.*

The following samples were sent for analysis by purchasers, many of whom did not give the particulars regarding the samples which are necessary to make them of any public interest and value and thus to justify the analyses at the state expense.

24170, sent by W. A. Henry & Son, Wallingford. **24293,** sold by the Vermont Lime Co., Greenfield, Mass.; sent by J. F. Carpenter, Putnam. **24583,** "Lime and Ashes," sold by the Knox Fertz'r Co., Rockland, Me.; sent by L. P. Abbe, Hazardville. **24629,** Caledonia Marl, sold by Caledonia Marl Co.; sent by F. A. Hamilton, Warehouse Point. **24630,** sent by C. M. Jarvis, Berlin. **24682,** Damp Forked Lime, sold by Buffalo Fertilizer Co.; sent by C. B. Treadwell, New Canaan. **24744,** sold by Buffalo Fertilizer Co.; sent by E. H. Nevers, Burnside. **24854,** from a pile of refuse lime in Bethel; **24855,** lime from the Redding Kiln, both sent by I. C. Fanton, Westport. **25173,** sent by H. E. Clark, Middlebury. **25176,** sent by E. E. Burwell, New Haven. **25198,** sold by W. L. Mitchell, New Haven, sent by F. Lyman, Manchester.

24853. Oyster Shell Dust, sold by the Adamant Plaster Co., New Haven, and sent by A. A. Young, Jewett City.

ANALYSES.

	24170	24293	24583	24629	24630	24682	24744
Moisture	----	----	17.29	----	27.80	23.47	----
Lime	60.62	69.91	47.50	47.40	39.87	58.30	49.54
Magnesia	0.77	5.57	2.97	----	4.88	----	2.35
Potash	----	----	0.60	----	----	----	----
Phosphoric acid	----	----	0.36	----	----	----	----
Insoluble in acid	0.65	7.57	3.36	----	----	----	----
Cost per ton	$4.00	7.00†	12.04	----	----	4.00	7.00

	24854	24855	25173	25176	25198	24853	
Moisture	33.18	----	----	----	----	----	----
Lime	27.90	47.00	49.82	34.14	60.70	42.39	----
Magnesia	16.79	32.78	----	----	----	----	----
Potash	----	----	----	----	----	----	----
Phosphoric acid	----	----	----	0.52	----	----	----
Insoluble in acid	----	----	----	----	----	----	----
Cost per ton	----	$5.00†	4.50†	10.00	5.00†	2.50	----

† At kiln.

These figures would have been interesting and instructive if those who sent the samples had given the particulars necessary

* See also page 453.

to give value to the analyses. As it is, most of them are almost worthless for the public.

With the constantly increasing demands on the station's time *it will be necessary hereafter to decline to analyze samples until* the station has received information about them sufficient to give general value to the analysis, and until the accuracy of the sample and of the information regarding it are vouched for.

COTTON HULL ASHES.

This valuable tobacco fertilizer has almost disappeared from our markets. Only four samples have been examined this year, as follows:

24249, car Erie 72333; **24407**, car C. St. P. M. & O. 24604; and **24857**, car I. C. 35399, all sold by American Cotton Oil Co., N. Y. C., through Spencer Bros., Suffield.

24683. Sold by Olds & Whipple; sampled and sent by F. B. Hathaway, Suffield.

ANALYSES.

Station No.	24249	24407	24857	24683
Percentage amount of				
Water-soluble potash	23.02	20.02	18.34	23.79
Cost per ton	$51.00	40.04	42.66	55.00
Potash costs cents per pound	9.7	10.0	10.0	10.2

WOOD ASHES.

24821. Bowker's Canada Hard Wood Ashes, sold by Bowker Fertilizer Co. and sampled from stock of Lightbourn & Pond Co., New Haven.

24257. Canada Hard Wood Ashes, sold by John Joynt, Lucknow, Can., and claimed to contain 6 per cent. of potash. Sampled and sent by O. S. Olmstead, Hazardville.

24627. Same brand, sampled and sent by Olds & Whipple, Hartford.

24628. Same brand, claimed to contain 4.0 per cent. of potash. Sampled and sent by Frank S. Platt Co., New Haven.

24582. Sold by F. R. Lalor, Dunnville, Can.; sampled and sent by F. B. Miller, Bloomfield.

24488. Sold by Geo. L. Munroe & Co.; sampled and sent by J. A. Sherwood, Long Hill.

ANALYSES.

Station No.	24821	24257	24627	24628	24582	24488
Percentage amounts of						
Total potash	....	4.86	3.95	4.07	5.98	3.43
Water-soluble potash	4.38	4.13	2.90	3.29	....	2.89
Phosphoric acid	1.71	1.47	1.00	1.43	1.68	1.36
Lime	31.58	30.00	24.88	18.82	31.20	27.11
Magnesia	4.85	3.92	5.05	4.73	3.33	4.79
Insoluble in acid	8.60	13.22	34.33	26.65	12.17	29.57
Moisture	15.52	18.23	5.50	24.50	10.63	20.45
Cost per ton	$18.00	13.21	12.00	18.00	11.00	11.00

HORSE MANURE FROM CITY STABLES.

Very large quantities of manure are brought into this state from Boston and New York horse stables and are used chiefly by tobacco farmers and market gardeners.

24574 is a sample carefully taken by Mr. W. M. Hinson of the U. S. Department of Agriculture from a car from Boston stables, bought by W. K. Ackley, East Hartford.

24575 is a sample of New York stable manure sampled like the last, at East Hartford. Their composition is as follows:

	24574	24575
Water	62.95	65.36
Organic matter*	32.99	30.70
Mineral matter†	4.06	3.94
	100.00	100.00
* Containing nitrogen	0.66	0.72
† Containing phosphoric acid	0.38	0.41
potash	0.59	0.64

These analyses show that the manure was rather drier than is usual, 70–75 per cent. of moisture being commonly present. Horse manure commonly contains from 0.50–0.75 per cent. of lime, one-third of that amount of magnesia and about 0.1 per cent. of chlorine.

SHEEP MANURE.

24641. Wizard Brand Manure, sold by the Pulverized Manure Co., Chicago, and sampled from stock of Lightbourn & Pond Co., New Haven.

24771. Pulverized Sheep Manure, sold by the A. A. C. Co. and sampled from stock of Greenwich Hardware Co.

24790. Pulverized Sheep Manure, sold by Natural Guano Co., Aurora, Ill., and sampled from stock of F. S. Bidwell & Co., Windsor Locks.

ANALYSES.

	24641	24771	24790
Nitrogen as ammonia	0.49	0.23	0.25
Nitrogen organic	2.01	2.12	1.95
Total nitrogen	2.50	2.35	2.20
Water-soluble phosphoric acid	1.15	0.77	0.40
Citrate-soluble " "	0.46	0.25	0.70
Citrate-insoluble " "	0.17	0.20	0.28
Total phosphoric acid	1.78	1.22	1.38
Potash calculated as muriate	0.78	0.84	0.70
" " " sulphate	0.91	0.75	1.30
Total potash	1.69	1.59	2.00
Cost per ton	$25.00	33.00	30.00

The analyses show that this material contains moderate amounts of nitrogen, phosphoric acid and potash which could be bought in forms of fertilizer chemicals for about $11 to $12 per ton.

It must also be remembered that 60 per cent. of sheep manure consists of fine vegetable matter which forms humus in the soil and has distinct value in feeding the soil bacteria and in regulating the water content of the soil.

DISSOLVED ANIMAL MATTER.

Stated to be made by the Peter Cooper's Glue Factory, sampled and sent by J. W. Crowell, Hartford, contained:

Nitrogen	1.48 per cent.
Water-soluble phosphoric acid	8.96
Citrate-soluble " "	1.82
Citrate-insoluble " "	1.87
Total phosphoric acid	12.65

The cost per ton is $19.00.

A sample of Hoof Meal, **23996**, contained 14.83 per cent. of nitrogen. Hoof, after thorough steaming, drying and grinding, seems to be a form of nitrogen fairly available to plants.

COCOON DUST.

A sample of this material, **23350,** is understood to consist of the dead bodies of silk worms, being a waste from Cheney's silk mills in South Manchester.

It has been found in practice to be a very strong fertilizer and the following analysis shows a high percentage of nitrogen:

Nitrogen	9.20 per cent.
Phosphoric acid	0.67
Potash	0.75
Matters insoluble in acid	5.31

SEWAGE WASTE.

23974. Sent by H. Kamp, Rockville, is understood to be the sludge which accumulates on the sand beds used for the purification of sewage and was sent to learn if it had value as a fertilizer.

It contains:

Water	68.00 per cent.
Nitrogen	1.34
Phosphoric acid	0.22
Potash	0.03

This material has almost three times as much nitrogen as stable manure, but it is probably much less fully available to crops because the more soluble and valuable part of the nitrogen has been removed by water and microbe action. Nevertheless, if it can be got for the hauling, it might pay for a short haul to plow under.

MISCELLANEOUS FERTILIZERS.

The following analyses do not represent goods offered for sale in this state and therefore have no general interest or value, but are here given in accordance with our rule to publish all analyses.

23979 and **23993**, sent by other stations to check their work, contained 2.99 per cent. of nitrogen and 5.74 per cent. respectively. **23982**, tankage, sent for opinion as to the availability of its nitrogen, contained 1.34 per cent. of nitrogen.

TOBACCO DUST AND TOBACCO STEMS.

23857 is a sample of tobacco dust from a tobacco factory, sampled and sent by J. & H. Woodford, Avon.

24826 is tobacco stems, sold by Olds & Whipple, Hartford; sampled and sent by E. P. Brewer, Silver Lane.

	23857	24826
Nitrogen as nitrate	....	0.59
" " ammonia	0.14	0.34
" organic	1.31	1.50
Total nitrogen	1.45	2.43
Phosphoric acid	0.43	0.49
Potash	1.83	5.80
Cost per ton		$14.00

NEW ENGLAND MINERAL FERTILIZER.

This material is made and sold by the New England Mineral Fertilizer Co. of Boston. It is stated by the manufacturer that this is not a lava but a "natural product," finely ground in water, and is sold from $10.00 per ton upwards, depending on the amount of the order.

It is claimed that with a proper application of this material three-fourths of all the insect life which preys on crops will be destroyed in soil and plant; that the manufacturer of these goods is giving twice the value of the ordinary commercial fertilizer at less than one-third the cost.

The analysis of a sample taken from a bag sent by the manufacturer showed 90.92 per cent. of silica and silicates undecomposed and insoluble in strong boiling hydrochloric acid. The acid dissolved 0.28 per cent. of phosphoric acid and 0.36 per cent. of potash.

No further comment on this material as a fertilizer is necessary. If there are any farmers who believe that finely ground stones can enrich the more finely ground rock dust which is *already in our soils and that these ground stones are six times* as valuable as commercial fertilizers, to such farmers the claims made for this fertilizer may appeal. To others they will appear so preposterous as to be unworthy of discussion.

MUCK AND SEA MUD.

23983, **23984**, and **23985** are samples taken from a swamp at the depths of 4½ feet, 2 feet and a few inches, respectively. The lower sample has the same appearance as the muck down to 12 feet. The samples were sent by E. K. Catlin, Torrington.

24173 is described as "muck from farm," sent by J. C. Wilcoxson, Stratford.

24172 was sent by Hubert D. Goodale, Stamford, with the question whether, with or without lime, it could be used in place of stable manure.

23847, sent by Walter E. Coe, Stamford, is stated to be leaf muck from a bed a half mile long and one-quarter mile wide and at least fifteen feet deep, surrounded by high banks. It is apparently a pond basin. Large hardwood trees are found on it and there is water below.

23893. Peat taken from a swamp on the farm of Thomas L. Brown, Black Hall. The sample is drier than the muck usually is because of the exceptionally dry season. Mr. Brown reports that corn grown on rather poor land dressed with this peat yielded as well as where stable manure was used and twice as much as where nothing was applied.

For comparison, **24668** represents a compost of peat or muck and fresh porgies or menhaden which was made in the summer of 1909 and used last spring on corn land with excellent results. Sent by C. W. Scranton, New Haven.

24174 is sea mud, sent by G. D. Tillinghast, Westerly, R. I., who states that he has an unlimited supply of it at hand and wishes, if it proves suitable, to substitute it for stable manure in market gardening.

The composition of these samples is as follows:

ANALYSIS OF PEAT OR MUCK AND MARINE MUD AS RECEIVED.

	23983	23984	23985	24173	24172	23847	23893	24668	24174
Water	54.71	66.29	61.68	52.73	2.87	85.62	69.54	71.70	53.9[illegible]
Organic matter	5.65	14.30	20.63	8.88	19.01	11.65	25.25	21.84	3.96
Mineral matter	39.64	19.41	17.69	38.39	78.12	2.73	5.21	6.46	42.05
	100.00	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*
Nitrogen	0.20	0.50	0.75	0.34	0.44	0.31	0.85	0.95	0.17
Phosphoric acid	....	....	....	....	....	trace	....	0.77	0.19
Potash	....	....	....	....	....	trace	....	....	trace
Calculated Water-Free.									
Organic matter	12.49	42.42	53.84	18.78	19.54	81.03	82.90	77.09	8.62
Mineral matter	87.51	57.58	46.16	81.22	80.46	18.97	17.10	22.91	91.38
	100.00	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*
Nitrogen	0.45	1.50	1.96	0.73	0.45	2.18	2.79	3.35	0.37
Phosphoric acid	....	....	....	....	....	0.09	....	2.72	0.42
Potash	....	....	....	....	....	0.05	....	....	0.03

Marine Mud.

There is little actual plant food in this sample, **24174,** and over 90 per cent. of it is very fine sand, with a little carbonate of lime.

If dug in summer this marine mud is said to bake hard, but if heaped up in winter the frost crumbles it as fine as ashes and, in spite of the facts shown by chemical analysis, farm practice has shown profit, in some cases, from its use *on light soils* where applied at the rate of 800 to 1,000 bushels per acre on corn, potatoes, and as a top-dressing on pastures.

Its good effect probably consists in large part in making the soil finer by filling the spaces between the coarse particles. In this way the water-holding and carrying capacity of a soil is improved.

Fine sifted coal ashes sometimes have a very evident effect on light sandy soils which is to be explained in the same way.

Peat or Muck.

"Muck" originally meant dung or mixtures of dung and vegetable matter, and "peat" meant the dark mass resulting from the slow decay of vegetable matter under water or away from the air. Some now use the word "muck" for the surface layers of a swamp which are loose in texture and not fully rotted down, and designate as "peat" the lower layers which are quite uniform in color and texture. But at present the two words in common farm usage have nearly or quite the same meaning.

The analyses above given show fairly the very various sorts of swamp or pond deposits called "muck" or "peat."

One of the samples, as the analysis shows, was almost perfectly dried before sending; the others contained from 52 to 85 per cent. of water, those having the most water which contained most vegetable matter. These analyses can best be studied by calculating them to a water-free basis, since the water is a very variable constituent, changing constantly with the weather and the seasons.

The water-free analyses show in the first place that these mucks vary greatly in their quality, ranging from samples like that at the left of the table, which is merely soil or sand with enough leaf-mold or other vegetable matter in it to make it dark or black in color, to samples like those at the right of the muck samples, which are mostly vegetable matter, with relatively little sand.

In the next place, it is to be noted that mucks in general contain only small fractions of one per cent. of potash and phosphoric acid. The reason is clear when their origin is considered. Most of them are formed by the decay of leaves and grasses, often under water and always without free access of air. The material from which muck is formed is naturally poor in fertilizing matter and much of this has been leached out by water.

It will be noted once more that dry muck contains much more nitrogen than either phosphoric acid or potash, the percentage of nitrogen in the above samples ranging from 0.37 to 2.79.

These are doubtless higher percentages than were contained in the dry matter of the material from which these mucks were formed. This is because the slow destruction which turns fresh vegetable matter into muck burns out the non-nitrogenous matters, starch, sugar and woody fiber much more quickly and completely than it does the nitrogenous matters. As a consequence, nitrogenous matters form a larger part of the peat than of the vegetable matter from which it came.

This nitrogen, however, can only be slowly soluble and available to crops. Water has leached away the most soluble part of it, decay has doubtless released the more easily decomposed part of what remained and there are left in the muck forms of nitrogen which are insoluble and relatively undecomposable by the processes which go on in soil.

Pot experiments also show little immediate fertilizing effect from this nitrogen.

It is obvious, then, that the direct fertilizer value of peat or muck must be small. Compared with stable manure, mucks contain much less potash and phosphoric acid than manure and much more nitrogen, but the nitrogen of muck is much less available to crops than that of manure.

The value of muck as an absorbent in stables and manure piles and as an amendment on light sandy soils is great, but is little regarded at present.

The attention of farmers has been chiefly centered on the use of commercial fertilizers and too often to the neglect of that "manœuvering" or "tempering" of land by tillage, drainage and amendments which was earlier practiced with profit by our farmers. The great value of peat or muck as an amendment and the methods of its use cannot be discussed in the limits of this report.

The agricultural value of peat depends chiefly on its great power of absorbing and holding water and water vapor, its regulation of the soil temperature and its continual supply to the soil of carbonic acid resulting from its gradual decay.

That is, it tempers the soil.

Fifty years ago, Professor Johnson, formerly director of this station, after citing the experience of successful farmers in this state, gives it as their opinion, "That a well-made compost of two loads of muck and one of stable manure is equal to three loads of the manure itself." He adds: "This opinion is so well substantiated that we need not hesitate to pronounce it a fact, and if a fact, it is one which deserves to be painted in bold letters on every barn door in Connecticut."

The large deposits of swamp muck in this state are one of our "natural resources" which has thus far been "conserved" because its value has been disregarded. There are many sandy farm lands which are hungry for it.

The station will be glad to hear from any farmers who have recently used muck on their land and to learn their experience and opinion, as it contemplates a full discussion of its use at some future time.

24668 is a compost of whole fish and swamp muck which was made in the early summer of 1909 and used on corn land in the spring of 1910. The compost had a disagreeable musty smell, the fish were entirely disintegrated and the effects as a fertilizer and amendment were very satisfactory.

FURTHER ANALYSES OF LIME.

The following samples are additional to those given on page 444, having been overlooked in that tabulation. Samples **25183** to **25186** were sent by B. Betts, Fairfield, to ascertain their relative values.

25204 represents a shipment of lime bought on inspection of the dealer's sample **25205**. A comparison shows the uncertainties of "buying on sample." The goods delivered contained only two-thirds as much lime as the sample which was supposed to represent the shipment.

25636 is refuse lime from a kiln which has been exposed to the weather for some years and costing fifty cents a load. The

weight of a "load" would determine, with the analysis, the economy of the purchase.

ANALYSES.

	25183	25184	25185	25186	25204	25205	25636
Lime	56.20	62.20	62.94	35.42	44.84	66.93	36.52
Magnesia	3.45	0.99	1.01	0.72	....	....	24.46
Insoluble in acid ...	....	....	....	....	....	....	3.17

PART VI.

FIFTEENTH REPORT ON FOOD PRODUCTS AND THIRD REPORT ON DRUG PRODUCTS, 1910.

(Examined during the year ending July 31, 1910.)

BY JOHN PHILLIPS STREET.*

This station is required by law to make examinations of food products and drugs, to publish its findings and to report to the dairy commissioner all cases of adulteration or misbranding which are discovered. Under this law a large number of samples have been bought in various parts of the state and carefully examined, and all cases of adulteration or misbranding reported to the dairy commissioner. Prosecution for infractions of the law rests with this official, the station's duty being to determine the facts and supply expert testimony in case of prosecution.

The dairy commissioner and his deputy have sent a large number of samples of vinegar, molasses and butter, the sale of which is regulated by special statutes, as well as a limited number, about one hundred, of samples of other foods and drugs. These are but briefly noticed here, being discussed in the commissioner's report, where account is also given of the results of prosecution under the law.

Lastly, a number of samples of food and drug products have been examined for individuals, which will likewise receive brief mention.

* The analytical work herein described was done jointly with Messrs. Bailey, Morrison, Roe and Shepard.

I. FOOD PRODUCTS.

CANNED PEAS.

The canning of peas is a very important branch of the canning industry, tomatoes and corn only exceeding it in total output, and peas ranking second in value. The production of canned peas in the United States for 1907 was estimated at 6,505,961 cases,* with a value of $14,650,000. Wisconsin and New York lead in output, with Indiana, Michigan and Maryland also producing large quantities.

The garden pea, *Pisum sativum*, belongs to the legume family, the vegetables of which are exceedingly rich in protein, and therefore of great importance in the human dietary. Dried peas contain about 24 per cent. of protein. The fresh peas, with about 75 per cent. of water, naturally contain much less protein, about 5.5 per cent., while the protein of canned peas falls to about 3.5 per cent., portions of the nitrogenous matter being leached out in the washing and blanching, and dissolved in the brine in which the peas are packed.

The method of growing peas for canning purposes, and the various processes employed at the factory in their preparation for human food are described fully by Bitting.†

The Grading of Peas.

Peas are graded at the factory both as to quality and size. The quality chiefly depends on their maturity or hardness. They are graded for quality by passing through tanks containing salt solutions of different densities, the young peas floating even in a rather dilute salt solution, and the very mature peas sinking in one much more concentrated. In practice three grades have been established as to quality:

1st. Float in salt solution, sp. gr. 1.040.

2d. Sink in salt solution, sp. gr. 1.040, float in solution, sp. gr. 1.070.

3d. Sink in salt solution, sp. gr. 1.070.

The lightest peas are of even quality, tender and succulent. The next class are of good quality but less uniform and of darker

* The Canner and Dried Fruit Packer, December 26, 1907.

† The Canning of Peas, U. S. Dept. Agr., Bur. of Chem., 1909, Bull. 125.

color, and the heaviest peas are uneven in quality, hard, and often of bad color. The mature peas would be the preferable purchase if their nutritive qualities were the only desideratum, for they contain more solid matter, and more protein and starch. But delicacy and flavor are important qualities, and these are found in the young and tender peas of the first grade.

Peas are also graded as to size by passing them over revolving cylinders containing perforations of different diameters. The sizes adopted by the trade are as follows:

No. 1. Petits Pois, less than $^9/_{32}$ in. diameter.
No. 2. Extra Sifted, or Extra Fins, $^9/_{32}$ to $^{10}/_{32}$ in. diameter.
No. 3. Sifted or Fins, $^{10}/_{32}$ to $^{11}/_{32}$ in. diameter.
No. 4. Early June, $^{11}/_{32}$ to $^{12}/_{32}$ in. diameter.
No. 5. Marrowfats, $^{12}/_{32}$ to $^{13}/_{32}$ in. diameter.
No. 6. Telephone, over $^{13}/_{32}$ in. diameter.

In some factories sizes 5 and 6 are combined under the general name "Marrowfats."

All of these size names have a definite meaning in the trade, but often convey a false impression to the purchaser. "Early June," for instance, is a size name, and does not refer to the season when the peas are picked. Our examinations also show that in all the grades the label does not always correctly indicate the size of the peas.

Details of Examination.

One hundred and eleven samples were analyzed, representing as many brands and the product of seventy-three manufacturers or jobbers. All the samples were subjected to a thorough physical and chemical examination.

Table I gives the brand names and manufacturers of the samples examined.

TABLE I.—BRANDS OF CANNED PEAS.

* Labeled "Colored with Sulphate of Copper." † Added Sugar indicated on label.

23834. Packed for Acker, Merrall & Condit Co., New York. Amcehat Brand Early June.
23756. Algoma Packing Co., Algoma, Wis. Sifted Wisconsin.
23833. Packed for Allen-Ditchett Co., New York. Our Initial Brand Sweet Wrinkled.
23958. Dist. by S. K. Ames, Boston. Ames' Quality Brand Selected.
*23927. A. and P. Brand, Wespelaer, Belgium. Medium.
*23931. Barton Brand, Imported. Fine.

23800. Batavia Preserving Co., Batavia, N. Y. Aetna Brand June.
†23820. " " " " " Royalton Brand.
23941. Dist. by A. T. Beckmann & Co., New York. Gold Rock Brand.
23815. Bonnie Meade Canning Co., Randolph, Wis. Bonnie Brand Petits Pois.
†23785. Burt Olney Canning Co., Oneida, N. Y. American Club Brand Sifted Sweet Wrinkled.
23947. Burt Olney Canning Co., Oneida, N. Y. Napoleon Brand French Petits Pois.
†23946. Burt Olney Canning Co., Oneida, N. Y. Napoleon Telephone Extra Tender Sugar.
†23765. Burt Olney Canning Co., Oneida, N. Y. Oneida Chief Brand Telephone.
23751. Burt Olney Canning Co., Oneida, N. Y. Rose of Sharon Brand Sifted Sweet.
†23786. Burt Olney Canning Co., Oneida, N. Y. St. Lawrence Brand Tender Sweet.
23780. Byron Brand Choice Telephone.
23945. H. P. Cannon, Bridgeville, Ind. Diamond State Brand Early June.
23760. Cheboygan Pea Canning Co., Cheboygan, Mich. Mackinac Brand Sifted.
†23811. Cherry Creek Canning Co., Cherry Creek, N. Y. Emerald Brand Sweet Sifted.
23943. Cherry Creek Canning Co., Cherry Creek, N. Y. Prize Winner Sifted Sweet.
23954. Cohocton Canning Co., Cohocton, N. Y. Three "C" Brand Early June.
†23939. Columbus Canning Co., Columbus, Wis. College Brand Wisconsin Sugar.
*23749. LaCorbeille Wespelaer Société Anonyme Petits Pois Fins.
*23807. Corbeille Brand Wespelaer Extra Fine.
*23949. G. Cremer, Malines, Belgium. Petits Pois Très Fins.
23752. Curtice Bros. Co., Rochester, N. Y. Blue Label Extra Fine.
23956. Packed for F. H. Davis & Co., New London. Davisco Brand Extra Sifted.
23930. Packed for Lewis DeGroff & Son, New York. Health Brand Sugar.
23821. Draper & Hirch, Milford, Del. Milford Brand Early June.
23803. Packed for R. N. Fitzgerald Co., Hartford. Bon Ton Brand Early June.
23950. Packed for R. N. Fitzgerald Co., Hartford. Mascot Brand Sweet Early June.
23796. Fort Stanwix Canning Co., Rome, N. Y. Flag Brand Early June.
†23802. Fort Stanwix Canning Co., Rome, N. Y. Fulton's Pride Brand Sifted Little Sweet Champion.
†23805. Fort Stanwix Canning Co., Rome, N. Y. Morning Dawn Brand Telephone Extra Tender Sugar.

†23955. Fox Lake Canning Co., Fox Lake, Wis. Square Deal Brand Wisconsin Early June.

*23791. François Brand Extra Fine French Peas, Bordeaux, France.

23774. Franklinville Canning Co., Franklinville, N. Y. Blue Bells Brand Sifted June.

23772. Fredonia Preserving Co., Fredonia, N. Y. Bridal Bell Early June Sifted.

23787. Fredonia Preserving Co., Fredonia, N. Y. Butter-Nut Brand Early June Sifted (packed for The F. C. Bushnell Co.).

23778. Fredonia Preserving Co., Fredonia, N. Y. Fedora Early June Sifted.

23735. Fredonia Preserving Co., Fredonia, N. Y. Magnes Brand Marrow Sifted.

23822. Fredonia Preserving Co., Fredonia, N. Y. Silver Edge Marrowfat Sifted.

23754. Genesee Valley Pres. Co., East Rock, N. Y. Valley Farm Standard.

23753. Geneseo Canning Co., Geneseo, N. Y. Blue Star Brand Marrow.

23830. Geneva Preserving Co., Geneva, N. Y. Lotus Brand Sweet Wrinkled.

23733. Put up for The Great Atl. and Pac. Tea Co., Jersey City, N. J. Iona Brand.

23953. Packed for The Great Atl. and Pac. Tea Co., Jersey City, N. J. Reliable Brand.

23748. The Great Atl. and Pac. Tea Co., Jersey City, N. J. Sultana Brand.

†23773. H. C. Hemingway & Co., Clyde, N. Y. Alpine Brand Early June Extra Sifted.

†23790. H. C. Hemingway & Co., Auburn, N. Y. Auburn Brand Early June Sifted.

†23776. H. C. Hemingway & Co., Syracuse, N. Y. Exposition Brand Sweet Wrinkled.

23932. Robert Hill, New York. Little Oliver Brand Extra Sifted Early June.

23928. Grafton Johnson, Greenwood, Ind. Fame Brand Telephone.

23759. Grafton Johnson, Tifton, Ind. Idyl Brand.

23736. Grafton Johnson, Whiteland, Ind. Our Favorite Brand Early June.

23944. Grafton Johnson, Whiteland, Ind. Our Favorite Brand Early June.

23824. Packed for The E. S. Kibbe Co., Hartford. Helmet Brand Sifted Sugar.

23747. Packed for The E. S. Kibbe Co., Hartford. Blue Petre Brand Sugar.

23832. J. Langrall & Bro., Baltimore, Md. Maryland Chief Early June.

23940. Dist. by Francis H. Leggett & Co., New York. Carleton Brand Sugar.

23793. Lemoine Petits Pois Fins, Bordeaux, France.

23737. Lenox Canning Co., Lenox, N. Y. Homes Sweetest Marrowfat Sifted.
*23816. Le Soleil Petits Pois Moyens No. 1, Malines, Belgium.
*23825. Le Soleil Petits Pois Moyens No. 2, Malines, Belgium.
23797. Lord-Mott Co., Baltimore, Md. Hunter Brand Early June.
23810. Wm. McKinley Canning Co., Lenox, N. Y. Gladstone Brand Marrowfat Sifted.
23809. Wm. McKinley Canning Co., Lenox, N. Y. Golden Brand French Petits Pois.
23784. Miller Bros. & Co., Baltimore, Md. Hawkins Point Brand Early June.
23738. Packed for Miner, Read & Garrette, New Haven. Sphinx Brand Sweet Wrinkled.
23799. Dist. by Chas. E. Moody & Co., Boston. Matchless Brand Champion Sugar.
*23812. Morel Brand, Belgium. Fine.
23766. Oconto Canning Co., Oconto, Wis. Mignonette Brand Extra Telephone.
23777. Oswego Preserving Co., Oswego, N. Y. Cameo Brand Sweet.
23788. Oswego Preserving Co., Oswego, N. Y. Golden Key Brand Sifted Sweet.
23764. Oswego Preserving Co., Oswego, N. Y. Huntress Brand Sweet Wrinkled.
23792. Oswego Preserving Co., Oswego, N. Y. Magnet Brand Early June.
23826. Oswego Preserving Co., Oswego, N. Y. Oswego Brand Petits Pois.
†23761. Oswego Preserving Co., Oswego, N. Y. Silver Key Brand Early June.
23798. Pennellville Canning Co., Camden, N. Y. National Park Brand Sugar Admiral.
23937. Phillips Packing Co., Cambridge, Md. Castle Haven Brand Early June.
23775. Potter & Wrightington, Boston. Azalea Brand Sugar.
23817. Potter & Wrightington, Boston. Brier Bush Brand.
23779. Potter & Wrightington, Boston (Northern Canning Co.). Golden Helmet.
23929. Dist. by Jas. G. Powers & Co., New York. Century Brand Sweet Wrinkle.
*23755. L. A. Price, Bordeaux, France. Fine.
23959. Randolph Canning Co., Randolph, Wis. Randolph Brand Sweet Sifted.
23808. Rodier Fils et Cie, Paris, France. Petits Pois Fins.
23819. Dist. by Seeman Bros., New York. Savoy Brand.
23831. Dist. by Seeman Bros., New York. Warfield Brand Sweet Wrinkled.
23813. Dist. by Seeman Bros., New York. Waverly Brand Delicious Sweet.

23814. Dist. by Seeman Bros., New York. White Rose Brand Petite Peas.

23804. Dist. by John S. Sills & Sons, New York. Epicure Brand Sugar.

23795. Silver Creek Pres. Co., Silver Creek, N. Y. Silver Dollar Brand Sifted Sweet Wrinkled.

23806. Dist. by Sprague, Warner & Co., Chicago. Richelieu Brand XXX Sifted Sweet Wrinkled.

23739. The Springville Canning Co., Springville, N. Y. Robin Brand Marrow.

23957. Sussex Packing Co., Seaford, Del. Fidelity Brand Early June.

23740. A. J. Tanner Co., Oakfield, N. Y. Golden Tip Brand Sweet Wrinkled.

23789. Tipton Canning Co., Tipton, Ind. Sweetstakes Early June.

23942. Tipton Canning Co., Tipton, Ind. Tip Top Brand June.

*23750. P. Tirot et Cie., Nantes, France. Petits Pois Extra Fins Des *Marquises*.

23745. Varick Brand, Standard Early June.

†23801. Waterloo Preserving Co., Waterloo, N. Y. Trophy Brand Sweet Wrinkle.

*23936. Petits Pois sur Extra Fine Fleur, A. and P., Wespelaer, Belgium.

†23744. Dist by R. C. Williams & Co., New York. Red Line Early June.

†23823. Dist. by R. C. Williams & Co., New York. Robin Hood Brand Crinkled Sweet.

†23938. Dist. by R. C. Williams & Co., New York. Royal Scarlet Small Tender.

23746. Wilson Canning Co., Mexico, N. Y. Lily Brand Fancy Sweet Wrinkled.

23828. Winters & Prophet, Mt. Morris, N. Y. Choicest Pickings Sweet Wrinkled.

23743. Winters & Prophet Canning Co., Mt. Morris, N. Y. Empire Brand Sweet Wrinkled.

23734. Winters & Prophet Canning Co., Mt. Morris, N. Y. Old Colony Brand Sweet Wrinkled.

Weight of Peas.

On opening the cans the contents were poured on a sieve and the peas allowed to drain for one minute. The following data as to the respective amounts of peas and liquor was thus obtained:

	Max.	*Min.*	*Ave.*
Weight of Can and Contents, gms.	723	380	672
" " Peas and Liquor, gms.	623	315	570
" " Drained Peas, gms.	455	211	364
" " Liquor, gms.	305	101	206
Per cent. of Liquor, by weight	*49.7*	*27.0*	*36.1*

TABLE II.—PHYSICAL EXAMINA

Station Number.	Sold as	Weight of Can and Contents.	Weight of Peas and Liquor.	Weight of Drained Peas.	Weight of Liquor.	Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appe Li
	Petits Pois.	gms.	gms.	gms.	gms.		cts.	cts.		
23936	A. and P.	517	424	277	147	34.7	18	29.5	none	sl. cl.
23815	Bonnie Meade	701	600	370	230	38.3	18	22.1	sl.	cl.
23947	Burt Olney	391	322	211	111	34.5	18	38.7	cons.	sl. cl.
23949	Cremer	496	406	274	132	32.5	20	33.1	sl.	cl.
23816	Le Soleil, No. 1	530	437	287	150	34.3	15	23.7	none	cl., gre
23825	" No. 2	517	419	293	126	30.1	15	23.2	"	"
23809	McKinley	380	315	214	101	32.1	15	31.8	sl.	sl. cl.
23826	Oswego	701	591	362	229	38.7	25	31.3	cons.	cl.
23814	Seeman	704	603	380	230	37.0	25	29.8	"	"
	Petits Pois Extra Fins.									
23750	Tirot	513	434	311	123	28.3	25	36.5	very sl.	sl. cl.
	Petits Pois Fins.									
23749	La Corbeille	511	415	268	147	35.4	20	33.9	sl.	"
23793	Lemoine	519	428	274	154	36.0	15	24.8	none	cl., gre
23808	Rodier	520	437	281	156	35.7	18	29.1	sl.	sl. cl., g
	Extra Fins or Extra Sifted.									
23807	Corbeille	505	410	261	149	36.3	20	34.8	none	"
23752	Curtice	692	584	364	220	37.7	25	31.2	sl.	cl.
23956	Davis	700	591	398	193	32.7	13	14.8	cons.	rather t
23791	François	542	450	313	137	30.4	20	29.0	none	sl. cl.
	Early June Extra Sifted.									
23773	Hemingway	676	575	366	209	36.3	15	18.6	much	cl.
23932	Hill	694	596	395	201	33.7	15	17.2	very sl.	"
	Sifted or Fins.									
23756	Algoma	705	598	411	187	31.3	9	9.9	sl.	thick
23931	Barton	491	393	243	150	38.2	12	22.3	cons.	sl. cl.
23785	Burt Olney (Amer. Club)	710	605	423	182	30.1	15	16.1	sl.	cl.
23751	" (Rose of Sharon)	698	595	386	209	35.1	15	17.6	cons.	"
23760	Cheboygan	697	594	366	228	38.6	10	12.4	sl.	thick
23811	Cherry Creek (Emerald)	710	607	413	194	32.0	13	14.3	cons.	"
23943	" (Prize Winner)	704	599	384	215	35.9	12	14.2	"	cl.
23802	Fort Stanwix	697	590	376	214	36.3	20	24.1	"	"
23774	Franklinville	714	603	417	186	30.9	10	10.9	"	thick
23824	Kibbe	702	596	354	242	40.6	15	19.2	sl.	cl.
23812	Morel	533	434	281	153	35.3	18	29.1	none	"
23788	Oswego	699	591	370	221	37.4	12	14.7	very sl.	"
23755	Price	537	447	293	154	34.5	30	46.4	"	"
23959	Randolph	700	595	353	242	40.7	10	12.9	sl.	"
23795	Silver Creek	706	602	385	217	36.0	10	11.8	"	"
23806	Sprague, Warner & Co.	692	588	377	211	35.9	15	18.0	cons.	"
	Early June Sifted.									
23772	Fredonia (Bridal Bell)	716	609	404	205	33.7	15	16.8	"	"
23787	" (Butter-Nut)	721	609	401	208	34.2	15	17.0	sl.	"
23778	" (Fedora)	717	612	383	220	37.4	10	11.8	cons.	"

OF CANNED PEAS.

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size. Petits Pois (No. 1).	Extra Fins or Extra Sifted (No. 2).	Fins or Sifted (No. 3).	Early June (No. 4).	Marrowfat (No. 5).	Telephone (No. 6).	Graded as to specific gravity. Float in NaCl solution, sp. gr. 1.04.	Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution	Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms	%	%	%	%	%	%		%	%
23936	0.1	0.2	yell. gr.	good	no	16	100	--	--	--	--	--	5	86	9
23815	0.4	0.4	"	soft	"	23	93	7	--	--	--	--	0	54	46
23947	0.4	0.1	"	good	"	23	60	40	--	--	--	--	7	82	11
23949	0.4	−0.1	br. gr.	sl. hard	"	24	24	76	--	--	--	--	2	25	73
23816	0.2	0.1	"	good	"	31	2	72	26	--	--	--	8	21	71
23825	0.5	0.0	"	sl. hard	"	37	---	20	80	--	--	--	1	8	91
23809	0.4	0.0	yell. gr.	good	"	22	79	21	--	--	--	--	8	37	55
23826	0.3	0.5	"	"	"	20	96	4	--	--	--	--	3	19	78
23814	0.4	0.3	"	"	"	21	89	11	--	--	--	--	2	48	50
23750	0.1	−0.2	gr. & yell. gr.	hard & soft	"	16	100	--	--	--	--	--	11	61	28
23749	0.4	0.1	light gr.	good	"	25	61	39	--	--	--	--	1	10	89
23793	0.1	0.2	br. gr.	rather hard	"	26	42	57	1	--	--	--	4	39	57
23808	0.2	0.3	light gr.	good	"	25	48	52	--	--	--	--	2	26	72
23807	0.1	0.1	light gr.	good	"	18	100	--	--	--	--	--	19	74	7
23752	0.5	0.2	yell. gr.	hard & soft	yes	21	98	2	--	--	--	--	1	25	74
23956	0.4	0.3	"	soft	in some	40	---	12	55	33	--	--	3	11	86
23791	0.1	0.0	light gr.	hard & soft	no	20	100	--	--	--	--	--	5	76	19
23773	0.5	0.3	yell. gr.	rather hard	"	32	---	39	61	--	--	--	1	1	98
23932	0.2	0.2	"	very soft	"	17	100	--	--	--	--	--	17	82	1
23756	0.5	0.1	yell. gr.	soft, mushy	"	39	---	31	53	16	--	--	2	1	97
23931	0.2	0.2	br. gr.	sl. hard	sl.	25	31	66	3	--	--	--	0	16	84
23785	0.4	−0.2	yell. gr.	good	no	34	---	47	53	--	--	--	0	0	100
23751	0.4	−0.2	"	hard & soft	yes	42	11	86	3	--	--	--	1	16	83
23760	0.4	0.3	"	hard	no	42	---	18	48	30	4	--	2	10	88
23811	0.3	0.1	"	sl. hard	yes	36	2	52	43	3	--	--	0	2	98
23943	0.4	0.4	"	sl. soft	in some	38	2	16	55	27	--	--	2	29	69
23802	0.4	0.2	"	rather soft	no	25	47	53	--	--	--	--	0	29	71
23774	0.3	0.1	"	rather hard	yes	37	---	31	52	17	--	--	0	2	98
23824	0.4	0.6	"	good	"	50	---	--	11	75	14	--	0	4	96
23812	0.2	0.3	light gr.	"	no	30	5	94	1	--	--	--	3	23	74
23788	0.4	0.4	yell. gr.	"	"	41	--	6	51	43	--	--	0	0	100
23755	0.1	0.1	light gr.	hard	"	22	100	--	--	--	--	--	3	26	71
23959	0.5	0.5	yell. gr.	soft	"	25	34	51	15	--	--	--	8	59	33
23795	0.4	0.3	"	hard	yes	51	---	2	15	72	11	--	0	19	81
23806	0.4	0.3	"	very soft	no	25	62	38	--	--	--	--	6	44	50
23772	0.4	0.3	light yell. gr.	rather hard	"	31	2	69	29	--	--	--	0	1	99
23787	0.4	0.3	" "	good	"	28	11	82	7	--	--	--	1	1	98
23778	0.4	0.5	yell. gr.	"	"	38	---	15	68	17	--	--	1	1	98
23790	0.6	0.4	light yell. gr.	rather hard	in some	41	---	2	73	25	--	--	0	2	98

TABLE II.—PHYSICAL EXAMINATION

Station Number.	Sold as	Weight of Can and Contents.	Weight of Peas and Liquor.	Weight of Drained Peas.	Weight of Liquor.	Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appearance of Liquor.
	Early June.	gms.	gms.	gms.	gms.		cts.	cts.		
23834	Acker, Merrall & Condit	711	609	390	219	36.0	12	14.0	very sl.	thick
23945	Cannon	699	595	374	221	37.1	10	12.1	cons.	"
23954	Cohocton	705	601	368	233	38.8	9	11.1	sl.	cl.
23821	Draper & Hirsch	694	593	370	223	37.6	10	12.3	"	thick
23803	Fitzgerald (Bon Ton)	700	593	379	214	36.1	12	14.4	cons.	cl.
23950	" (Mascot)	698	587	367	220	37.5	15	18.5	sl.	thick
23796	Fort Stanwix	701	606	358	248	40.9	12	15.2	cons.	cl.
23955	Fox Lake	712	606	380	226	37.3	10	11.9	much	thick
23736	Grafton Johnson	680	585	401	184	31.5	10	11.3	sl.	very thick
23944	"	695	587	412	175	29.8	10	11.0	cons.	thick
23832	Langrall	684	579	361	218	37.7	12	15.1	sl.	very thick
23797	Lord-Mott	710	614	309	305	49.7	10	14.7	cons.	cl.
23784	Miller	690	588	330	258	43.9	10	13.7	"	thick
23792	Oswego (Magnet)	695	586	369	217	37.0	10	12.3	"	"
23761	" (Silver Key)	696	593	378	215	36.3	9	10.8	sl.	"
23937	Phillips	689	585	383	202	34.5	10	11.8	cons.	"
23957	Sussex	713	605	385	220	36.4	10	11.8	"	"
23789	Tifton	712	607	392	215	35.4	10	11.6	"	"
23745	Varick	698	608	384	224	36.8	10	11.8	sl.	"
23744	Williams	697	598	366	232	38.8	13	16.1	none	cl.
	Marrow Sifted.									
23735	Fredonia (Magnes)	723	623	455	168	27.0	13	13.0	sl.	very thick
23822	" (Silver Edge)	693	589	380	209	35.5	10	11.9	cons.	cl.
23737	Lenox	675	589	371	218	37.0	12	14.7	sl.	thick
23810	McKinley	683	582	373	209	35.9	12	14.6	cons.	cl.
	Marrow.									
23753	Geneseo	715	612	421	191	31.2	12	12.9	sl.	very thick
23739	Springville	711	614	400	214	34.9	10	11.3	"	thick
	Telephone.									
23946	Burt Olney (Napoleon)	718	612	391	221	36.1	15	17.4	cons.	"
23765	" (Oneida Chief)	710	607	412	195	32.1	15	16.5	very sl.	cl.
23780	Byron	697	585	364	221	37.8	10	12.5	sl.	"
23805	Fort Stanwix	701	593	354	239	40.3	15	19.2	cons.	"
23928	Grafton Johnson	693	598	407	191	37.8	10	11.1	"	thick
23766	Oconto	706	604	372	232	38.4	8	9.8	"	cl.
	Sweet Wrinkled.									
23833	Allen-Ditchett	718	611	389	222	36.3	15	17.5	sl.	thick
23830	Geneva	691	590	379	211	35.6	13	15.6	"	cl.
23776	Hemingway	679	576	345	231	40.0	10	13.1	"	"
23738	Miner, Read & Garrette	678	581	363	218	37.5	13	16.2	none	"
23764	Oswego	706	603	365	238	39.5	15	18.6	very sl.	"
23929	Powers	697	592	349	243	41.0	13	17.0	cons.	"
23831	Seeman	697	596	399	197	33.1	15	17.0	"	thick

OF CANNED PEAS—*Continued.*

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas.	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size. Petits Pois (No. 1).	Extra Fins or Extra Sifted (No. 2).	Fins or Sifted (No. 3).	Early June (No. 4).	Marrowfat (No. 5).	Telephone (No. 6).	Graded as to specific gravity. Float in NaCl solution, sp. gr. 1.04	Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution.	Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms.	%		%			%		%	%
3834	0.3	0.2	yell. gr.	good	yes	41	1	7	51	41	--	--	0	2	98
3945	0.4	0.5	"	very hard	"	46	---	--	17	74	9	--	0	0	100
3954	0.5	0.6	"	good	"	41	---	1	56	43	--	--	0	4	96
3821	0.5	0.5	"	sl. hard	"	42	---	14	44	41	1	--	0	0	100
3803	0.4	0.3	"	soft	"	52	---	--	15	64	21	--	3	19	78
3950	0.4	0.4	"	good	in some	39	---	4	43	53	--	--	1	68	31
3796	0.3	0.6	"	some soft	no	34	---	48	50	2	--	--	0	0	100
3955	0.5	0.5	"	hard	yes	48	---	--	12	88	--	--	0	0	100
3736	0.5	0.1	"	good	no	36	---	25	54	21	--	--	0	1	99
3944	0.5	0.1	"	sl. hard	yes	36	---	25	58	17	--	--	0	1	99
3832	0.5	0.8	"	rather hard	"	40	---	14	64	22	--	--	0	0	100
3797	0.3	1.3	yel. & yel. gr.	good	in some	43	---	8	54	38	--	--	0	0	100
3784	0.5	0.9	many yell., yell. gr.	old & hard	yes	45	---	2	35	63	--	--	0	0	100
3792	0.4	0.3	yell. & yell. gr.	" "	"	31	22	59	17	2	--	--	1	12	87
3761	0.5	0.2	yell. gr.	hard	"	40	---	12	50	38	--	--	0	1	99
3937	0.4	0.5	"	sl. soft	"	35	1	6	59	34	--	--	0	1	99
3957	0.4	0.4	"	very hard	"	46	---	5	29	53	13	--	0	0	100
3789	0.4	0.4	"	rather hard	"	46	---	--	37	58	5	--	0	3	97
3745	0.4	0.3	"	good	no	41	---	19	53	28	--	--	0	0	100
3744	0.5	0.3	"	"	"	41	---	16	54	30	--	--	0	1	99
3735	0.6	−0.2	yell. gr.	quite hard	yes	47	---	--	10	71	15	4	0	0	100
3822	0.4	0.1	"	good	"	49	---	2	17	64	17	--	0	12	88
3737	0.4	0.4	"	rather hard	"	45	---	--	25	72	3	--	0	7	93
3810	0.5	0.2	"	" "	"	51	1	1	17	48	32	1	2	14	84
3753	0.4	−0.2	yell. gr.	hard	"	44	---	6	65	29	--	--	0	1	99
3739	0.5	0.2	"	rather hard	"	41	---	1	38	51	10	--	0	0	100
3946	0.4	0.3	yell. gr.	good	in some	57	3	7	18	32	30	10	0	7	93
3765	0.4	0.0	"	many br'k'n	yes	49	1	8	29	37	17	8	2	3	95
3780	0.5	0.5	"	fair	"	63	---	--	6	37	46	11	0	4	96
3805	0.4	0.5	"	soft & hard	"	63	3	1	7	42	34	13	0	21	79
3928	0.4	0.3	"	hard	"	45	---	13	19	67	1	--	0	0	100
3766	0.3	0.3	"	"	"	61	---	--	--	43	39	18	0	0	100
3833	0.3	0.3	yell. gr.	good	"	51	---	2	8	77	13	--	0	5	95
3830	0.4	0.4	"	"	"	55	---	--	--	47	53	--	0	2	98
3776	0.5	0.3	"	hard, many broken	"	62	---	--	--	29	48	23	0	9	91
3738	0.5	0.3	"	poor, some mushy	"	65	--	--	--	7	66	27	0	11	89
3764	0.3	0.2	"	good	no	31	17	63	20	--	--	--	0	0	100
3929	0.3	0.5	"	"	yes	44	---	--	48	52	--	--	2	55	43
3831	0.2	0.3	"	very soft	no	32	13	39	41	7	--	--	2	39	59

TABLE II.—PHYSICAL EXAMINATION

Station Number.	Sold as	Weight of Can and Contents.	Weight of Peas and Liquor.	Weight of Drained Peas.	Weight of Liquor.	Per cent. Liquor.	Cost per Can.	Cost of Drained Peas per Pound.	Discoloration of Interior of Can.	Appearance of Liquor.
		gms.	gms.	gms.	gms.		cts.	cts.		
	Sweet Wrinkled.									
23740	Tanner	693	597	365	232	38.9	10	12.4	sl.	thick
23801	Waterloo	710	607	358	249	41.0	12	15.2	cons.	cl.
23823	Williams	712	604	379	225	37.3	15	18.0	"	"
23746	Wilson	680	585	361	224	38.3	13	16.3	sl.	"
23828	Winters & Prophet (Choicest Pickings)	714	606	406	200	33.0	15	16.8	"	thick
23743	Winters & Prophet (Empire)	692	601	394	207	34.4	13	15.0	"	cl.
23734	Winters & Prophet (Old Colony)	681	593	372	221	37.3	15	18.3	"	"
	Sweet or Sugar.									
23786	Burt Olney	714	611	398	213	34.9	10	11.4	cons.	thick
23939	Columbus	716	612	396	216	35.3	12	13.7	"	rather thick
23930	DeGraff	714	604	424	180	30.0	16	17.1	sl.	cl.
23747	Kibbe	694	588	394	194	33.0	15	17.3	cons.	"
23940	Leggett	683	579	354	225	38.8	13	16.7	sl.	thick
23799	Moody	707	605	404	201	33.2	18	20.2	cons.	cl.
23777	Oswego	710	607	393	214	35.3	10	11.5	sl.	"
23798	Pennellville	708	599	400	199	33.2	10	11.3	cons.	"
23775	Potter & Wrightington	695	598	378	220	36.8	12	14.4	"	"
23813	Seeman	713	608	391	217	35.7	16	18.6	sl.	"
23804	Sills	712	612	387	225	36.8	13	15.2	cons.	"
	Peas.									
23820	Batavia	715	604	385	219	36.3	9	10.6	"	"
23941	Beckmann	713	611	378	233	38.1	13	15.6	"	thick
23754	Genesee	715	609	366	243	40.0	10	12.4	much	"
23733	Gt. Atl. & Pac. Tea (Iona)	692	599	366	233	38.9	10	12.4	sl.	cl.
23953	" " (Reliable)	684	581	351	230	40.0	13	16.8	very sl.	thick
23748	" " (Sultana)	699	599	392	207	34.6	12	13.9	cons.	cl.
23759	Grafton Johnson	691	591	368	223	37.7	10	12.3	sl.	thick
23817	Potter & Wrightington (Brier Bush)	691	588	376	212	36.1	10	12.1	"	cl.
23779	Potter & Wrightington (Golden Helmet)	700	594	361	233	39.2	13	16.3	"	"
23819	Seeman	712	604	376	228	37.7	13	15.7	"	"
	Miscellaneous.									
23800	Batavia (June)	701	600	371	229	38.2	12	14.7	cons.	"
23942	Tipton (June)	661	557	397	160	28.7	10	11.4	"	very thick
23927	A. and P. (Medium)	515	419	270	149	35.6	13	21.8	none	sl. cl.
23958	Ames (Selected)	712	605	374	231	38.2	13	15.8	sl.	cl.
23938	Williams (Small Tender)	690	588	343	245	41.7	18	23.8	very sl.	"
	Maximum	*723*	*623*	*455*	*305*	*49.7*	*30*	*46.4*	----	------
	Minimum	*380*	*315*	*211*	*101*	*27.0*	*8*	*9.8*	----	------
	Average	*672*	*570*	*364*	*206*	*36.1*	*13.5*	*16.8*	----	------

OF CANNED PEAS.—*Concluded.*

Station Number.	Top of Can above level of Contents.	Depth of Liquor above Peas.	Color of Peas.	Consistency of Peas.	Cotyledons Prominent.	Weight of 100 Peas.	Graded as to Size. *Petits Pois* (No. 1).	Extra Fins or Extra Sifted (No. 2).	Fins or Sifted (No. 3).	*Early June* (No. 4).	Marrowfat (No. 5).	Telephone (No. 6).	Graded as to specific gravity. *Float in NaCl solution, sp. gr. 1.04.*	Sink in NaCl solution, sp. gr. 1.04, but float in 1.07 solution.	Sink in NaCl solution, sp. gr. 1.07.
	in.	in.				gms.	%	%	%	%	%			%	%
23740	0.5	0.3	yell. gr.	rather hard	yes	52	---	--	19	68	13	--	1	2	97
23801	0.4	0.5	"	" "	"	77	---	--	--	2	45	53	0	1	99
23823	0.3	0.4	"	fair	in some	40	---	18	54	28	--	--	0	12	88
23746	0.6	0.2	"	good	no	43	---	5	57	38	--	--	2	20	78
23828	0.4	0.2	"	"	in some	45	---	2	39	59	--	--	1	2	97
23743	0.3	0.2	"	"	no	30	---	17	50	33	--	--	0	16	84
23734	0.3	0.3	"	"	yes	39	---	8	69	23	--	--	1	1	98
23786	0.4	0.3	yell. gr.	rather hard	"	52	---	--	9	76	15	--	1	3	96
23939	0.3	0.2	"	good	"	32	---	70	30	--	--	--	3	52	45
23930	0.3	0.0	"	fair	"	47	1	8	26	46	19	--	1	20	79
23747	0.6	—0.2	"	hard & soft, s'me mushy	"	83	---	1	2	10	27	60	0	10	90
23940	0.5	0.5	"	hard	"	49	---	--	18	79	3	--	0	9	91
23799	0.3	0.1	"	rather soft	no	60	1	6	13	31	41	8	1	40	59
23777	0.3	0.2	"	good	in some	45	---	5	45	50	--	--	0	0	100
23798	0.4	0.1	"	rather hard	yes	51	---	--	14	76	10	--	1	8	91
23775	0.3	0.2	"	soft, some broken	"	39	---	24	38	37	1	--	2	47	51
23813	0.4	0.3		hard & soft	in some	54	7	11	12	31	26	13	3	13	84
23804	0.4	0.3	"	" "	yes	48	7	17	27	32	15	2	4	13	83
23820	0.5	0.4	yell. gr.	hard	"	43	---	4	50	46	--	--	0	3	97
23941	9.3	0.5	"	sl. hard	"	35	---	46	52	2	--	--	1	0	99
23754	0.4	0.2	yell. gr. & yell.	hard & old	"	45	3	13	22	47	15	--	1	7	92
23733	0.4	0.5	yell. gr.	rather soft	"	51	---	--	11	55	27	7	0	11	89
23953	0.5	0.5	"	good	no	33	---	43	56	1	--	--	2	72	26
23748	0.4	0.1	"	hard	"	33	---	79	21	--	--	--	5	5	90
23759	0.5	0.5	"	good	yes	35	2	52	45	1	--	--	0	1	99
23817	0.4	0.4	"	rather soft	"	45	---	8	43	48	1	--	2	31	67
23779	0.3	0.4	"	" "	no	37	---	25	75	--	--	--	0	44	56
23819	0.3	0.3	"	very soft	sl.	35	4	59	37	--	--	--	0	19	81
23800	0.4	0.4	yell. gr.	fair	yes	42	---	--	47	53	--	--	0	1	99
23942	0.7	0.0	"	sl. hard	"	46	---	--	35	59	6	--	0	0	100
23927	0.1	0.2	br. gr.	very hard	"	34	1	41	57	1	--	--	0	7	93
23958	0.5	0.4	yell. gr.	good	no	30	---	49	51	--	--	--	23	68	9
23938	0.4	0.7	"	"	in some	30	---	75	25	--	--	--	0	78	22
	0.7	*1.3*	----	----	----	*83*	*100*	*94*	*80*	*88*	*66*	*60*	*19*	*86*	*100*
	0.1	*—0.2*	----	----	----	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
	0.4	*0.3*	----	----	----	*40*	*14*	*20*	*29*	*28*	*7*	*2*	*2*	*18*	*80*

The liquor made up from about one-quarter to one-half of the total weight of the contents, on the average 36 per cent. This is important, in view of the fact that this liquor is almost always thrown away when preparing the peas for the table. The significance of this waste will be taken up in a later section.

The weight of the peas and liquor showed wide variations, but no more than would be expected in samples of varying size, quality and price. The following is a summary of the variation in weight of drained peas according to the sizes indicated on the label:

	Max.	*Min.*	*Ave.*
Petits Pois	380	211	292
Extra Sifted	398	261	350
Sifted	423	243	368
Early June	412	309	373
Marrowfat	455	371	400
Telephone	412	354	383
Miscellaneous	424	270	373

Quoting Bitting, "the average fill of a can (No. 2) is such that after processing there will be 14 ounces of peas (400 grams) and 7¼ ounces (200 grams) of liquor. . . . Any very marked deviation from these figures in the direction of reducing the proportion of peas would evidently be an adulteration with water, while any considerable increase in the proportion of peas would result in dryness. Cans containing only 11 or 12 ounces of peas are evidently short weight, though a customer can not reasonably demand more than 15 ounces as a maximum and expect a good appearance." The above remarks, of course, only apply to the No. 2 can most generally used. "Petits pois" and "extra sifted" are very frequently packed in much smaller cans, as is shown by the above summary. Of the ninety-two samples packed in No. 2 cans, fifty-six contained less than 385 grams of drained peas, thirty-one between 385 and 415 grams, and five over 415 grams. That is, 61 per cent. had a tendency toward short weight, 34 per cent. were normal and 5 per cent. contained too much peas for the liquor. The most prominent offenders in this respect were Nos. 23797, 23784 and 23938, where the drained peas weighed only 309, 330 and 343 grams, and the liquor made up 50, 44 and 42 per cent. of the total weight of the sample, respectively; and No. 23735, where the peas weighed 455 grams and the liquor made up only 27 per cent. of the weight and was very thick and generally unattractive.

Cost of Peas.

The cost per can ranged from 8 to 30 cents, with an average of 13.5. Here size of can and quality were also important factors, and a calculation based on the cost per pound of the drained peas in the different samples offers a more satisfactory basis of comparison. This ranged from 9.8 to 46.4 cents, with an average of 16.8. By consulting the tables it will be seen that the cost per pound on the average decreased quite regularly as the size increased, the "petits pois" averaging 29.8 cents, and the "marrowfats" and "telephones" averaging 13.1 and 14.4 cents, respectively. The young and tender peas, that is the peas of the finer quality, cost on the average about twice as much per pound as the larger and more mature peas.

Condition of the Peas on Opening.

Corrosion of Cans. In ten samples there was no discoloration or corrosion of the interior of the can, in fifty-two it was slight, in forty-six considerable, while in three, Nos. 23773, 23955 and 23754, it was very marked.

Clearness of Liquor. In no case was the liquor perfectly clear; it ranged from slightly cloudy to a very thick, pasty consistency. In ten samples the liquor was slightly cloudy, in sixty-three cloudy, in thirty-three thick and in five very thick and pasty.

Filling of the Can. According to Bitting, a can is well filled when the contents are within three-eighths of an inch of the cap, and the peas are just covered with liquor. In seven of the samples examined the contents were 0.1 in. from the cap, in six, 0.2 in., in twenty-one, 0.3 in., in forty-seven, 0.4 in., in twenty-five, 0.5 in., in four, 0.6 in., and in one, 0.7 in. Thirty samples, or 27 per cent., contained over 0.4 in. of empty can. The shortage was sometimes in the peas, sometimes in the liquor, and sometimes in both.

Too much liquor causes a deterioration of the peas, while insufficient liquor renders the peas less attractive and more likely to become pasty. In thirteen of the samples the liquor was insufficient to cover the peas, in thirty-one it was excessive, and in seven it was very excessive.

Color. In the great majority of the samples the color was satisfactory. The peas treated with copper had an unnatural

bright green color, and some of the more mature peas were distinctly yellow.

Consistency of the Peas. The consistency of the peas ranged from soft and mushy to hard. In some samples many of the peas were broken, indicating the probable use of "soaked" peas.

The prominence of the cotyledons is somewhat indicative of the maturity of the peas. In forty-two samples the cotyledons were not prominent, in fifty-six they were prominent, and in eleven some of the peas showed prominent cotyledons and some did not.

Weight of Peas. One hundred drained peas from each can were weighed before grading as to size and specific gravity. This weight ranged from 16 to 83 grams, with an average of 40 grams. The average weight of one hundred "petits pois" was 24 grams, "extra fins," 25 grams, "sifted," 35 grams, "early June", 41 grams, "marrowfats," 46 grams, and "telephones," 56 grams.

Grading as to Size. Of course, during "processing," peas naturally increase somewhat in weight and size. It is not to be expected, therefore, that the canned peas will grade up as accurately as they would in their natural fresh condition. Nevertheless, it is believed that the figures reported in the table indicate with reasonable accuracy the percentage of peas of the different grades found in the samples. In seventy-two of the 111 samples the label indicated a standard size. Of these twenty-three were found true to size, thirty-four of smaller size and fifteen of larger size. The proper grading for the whole number of samples would be twelve "petits pois," twenty "extra sifted," thirty-six "sifted," thirty-six "early June," five "marrowfat" and two "telephone." The following tabulation summarizes our grading as to size:

Sold as	Total Number.	Correct Grade. Petits Pois.	Extra Sifted.	Sifted.	Early June.	Marrowfat.	Telephone.	[illegible]
Petits Pois	13	6	5	2	--	--	--	[illegible]
[illegible]tra Sifted, or Extra Fins	6	4	0	1	1	--	--	[illegible]
[illegible]d or Fins	23	1	8	8	6	--	--	[illegible]
[illegible]une	22	--	1	12	9	--	--	[illegible]
No. [illegible]	2	--	--	1	1	--	--	[illegible]
[illegible]	6	--	--	--	5	1	--	[illegible]
made [illegible]icated generally	39	1	6	12	14	4	2	[illegible]
	111	12	20	36	36	5	2	[illegible]

All of the samples marked "early June," "marrowfat" or "telephone," were equal to or better than the grade claimed on the label. On the other hand, only 46 per cent. of the "petits pois," 67 per cent. of the "extra sifted" and 74 per cent. of the "sifted" were of as good grade as claimed on the label.

The weight of one hundred of the drained peas is a very satisfactory guide as to the size of the peas. The table giving the details of the physical examination of the peas shows that of the fourteen branded "petits pois," twelve ranged from 16 to 26 gms. weight per hundred peas, 23816 and 23825 showing 31 and 37 gms.; of the six "extra sifted," four showed from 17 to 21 gms., 23773 and 23956 showing 32 and 40 gms.; of the twenty "sifted," fourteen showed from 25 to 39 gms., 23790, 23788, 23751, 23760, 23824 and 23795 showing 41, 41, 42, 42, 50 and 51 gms. respectively; of the twenty "early June," nineteen showed from 31 to 48 gms., 23803 showing 52 gms.; the six "marrowfats" showed from 41 to 51 gms.; the six "telephones" from 45 to 63 gms. All of these eleven samples showed a large proportion of peas of greater size than indicated by the brand name, and are misbranded.

Specific Gravity. The figures obtained are very unsatisfactory and in most cases convey little useful information.

Chemical Examination.

Complete chemical analyses of the liquor and drained peas of all the samples are given in Table III; in Table IV the composition of the drained peas is given on the water-free basis.

The Pea Liquor.

This liquor generally consists of water, salt and sugar, the proportions of salt and sugar varying greatly at different factories. The use of sugar is frequently for the purpose of giving "a weak, insipid, sugarless pea some semblance of quality, also to make the smooth pea as sweet as the sweet wrinkled variety." * In eight of the samples in which sugar was declared on the label, glucose was present; in one of these cane sugar was specifically guaranteed, and this sample was clearly misbranded.

Some canners, recognizing the amount of extracted nutriment in the pea liquor, recommend its use in preparing peas for the

* Bitting, *loc. cit.*

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS.

Station Number.	Sold as	Liquor. Water.	Liquor. Ash.	Liquor. Protein (N x 6.25).	Liquor. Sucrose by Clerget.	Liquor. Undetermined, chiefly Starch.	Liquor. Sodium Chloride.	Liquor. Pea Ash.	Drained Peas. Water.	Drained Peas. Ether Extract.	Drained Peas. Fiber.	Drained Peas. Ash.	Drained Peas. Protein (N x 6.25).	Drained Peas. Nitrogen-free Extract.	Drained Peas. Sodium Chloride.	Drained Peas. Pea Ash.	Drained Peas. Reducing Sugars as Dextrose.	Drained Peas. Starch.	Drained Peas. Undetermined Carbohydrates.
23936	Petits Pois	94.78	0.60	1.38	2.34	0.90	0.34	0.26	87.30	0.26	1.36	0.67	3.27	7.14	0.27	0.40	1.93	3.88	1.33
23815	" "	93.00	1.32	1.44	3.08	1.16	1.03	0.29	86.66	0.26	1.27	1.24	2.88	7.69	0.89	0.35	2.78	4.14	0.77
23947	" "	94.33	0.87	1.44	3.15	0.21	0.64	0.23	86.26	0.49	1.52	0.89	3.27	7.57	0.51	0.38	2.96	3.44	1.17
23949	" "	94.40	0.94	1.07	2.36	1.23	0.66	0.28	83.31	0.31	1.90	0.96	3.75	9.77	0.47	0.49	2.09	6.55	1.13
23816	" "	95.31	1.26	1.42	0.75	1.26	0.90	0.36	81.70	0.22	2.01	1.15	4.38	10.54	0.68	0.47	0.83	8.54	1.17
23825	" "	94.47	1.35	1.69	1.04	1.45	0.99	0.36	81.72	0.21	1.88	1.20	4.07	10.92	0.72	0.48	0.80	8.63	1.49
23809	" "	94.85	1.12	1.49	1.74	0.80	0.81	0.31	86.10	0.33	1.42	1.04	3.00	8.11	0.65	0.39	1.90	5.23	0.98
23826	" "	94.06	1.23	1.10	2.53	1.08	0.98	0.25	84.99	0.27	1.51	1.17	3.17	8.89	0.77	0.40	2.63	5.56	0.70
23814	" "	93.44	1.17	1.31	3.00	1.08	0.92	0.25	86.16	0.29	1.35	1.10	3.22	7.88	0.76	0.34	1.96	4.77	1.15
23750	Petits Pois Extra Fins	94.15	0.96	1.56	1.47	1.86	0.63	0.33	85.30	0.29	1.68	0.95	4.11	7.67	0.52	0.43	1.82	4.63	1.22
23749	Petits Pois Fins	94.31	1.36	1.44	1.90	0.99	1.07	0.29	81.23	0.25	2.06	1.34	4.24	10.88	0.84	0.50	1.91	7.69	1.28
23793	" " "	95.84	0.95	0.96	1.53	0.72	0.76	0.19	83.55	0.21	1.96	0.94	3.67	9.67	0.55	0.39	1.42	6.79	1.46
23808	" " "	96.12	1.02	1.32	0.85	0.69	0.79	0.23	82.62	0.21	1.95	1.05	4.05	10.12	0.55	0.50	0.84	7.83	1.45
23807	Extra Fins or Extra Sifted	94.56	0.51	0.76	2.98	1.19	0.32	0.19	89.10	0.21	1.16	0.52	2.52	6.49	0.24	0.28	2.67	2.70	1.12
23752	" " " " "	94.71	1.16	1.41	1.74	0.98	0.90	0.26	85.21	0.49	1.78	1.12	4.04	7.36	0.71	0.41	1.99	4.18	1.19
23956	" " " " "	92.91	1.09	1.32	2.90	1.78	0.84	0.25	84.39	0.56	1.61	0.97	3.80	8.67	0.64	0.33	2.25	4.94	1.48
23791	" " " " "	95.31	0.73	1.09	2.22	0.65	0.54	0.19	87.62	0.15	1.29	0.76	3.08	7.10	0.41	0.35	2.07	3.92	1.11
23773	Early June Extra Sifted	93.63	1.24	1.65	2.06	1.42	0.85	0.39	78.39	0.37	1.82	1.16	4.81	13.45	0.64	0.52	2.09	10.37	0.99
23932	" " " "	94.08	0.77	1.48	2.77	0.90	0.54	0.23	90.46	0.30	0.94	0.71	2.84	4.75	0.41	0.30	1.46	2.04	1.25
23756	Sifted or Fins	91.05	1.51	2.26	2.73	2.45	1.05	0.46	75.94	0.39	1.78	1.28	5.19	15.42	0.76	0.52	2.61	11.74	1.07
23931	" " "	96.27	1.50	1.46	0.53	0.24	1.21	0.29	81.75	0.14	1.84	1.42	3.98	10.87	0.91	0.51	0.53	8.59	1.75
23785	" " "	92.21	1.09	1.66	3.13	1.91	0.75	0.34	78.12	0.40	1.69	1.03	4.36	14.40	0.52	0.51	3.39	8.84	2.17
23751	" " "	92.13	0.78	1.55	4.21	1.33	0.48	0.30	81.53	0.49	1.90	0.79	4.68	10.61	0.35	0.44	4.68	5.84	0.09
23760	" " "	92.84	1.51	1.45	2.93	1.27	1.18	0.23	79.79	0.54	2.03	1.45	5.55	10.64	0.98	0.47	3.01	6.19	1.44
23811	" " "	91.91	1.47	1.38	2.62	2.62	1.06	0.41	78.51	0.39	1.84	1.31	3.96	13.99	0.77	0.54	2.63	9.78	1.58
23943	" " "	91.70	1.00	1.13	4.91	1.26	0.70	0.30	84.49	0.59	1.53	0.87	3.51	9.01	0.47	0.40	3.69	4.26	1.06
23802	" " "	93.12	0.93	1.29	3.14	1.52	0.66	0.27	82.85	0.36	1.53	0.87	3.26	11.13	0.44	0.43	3.49	6.93	0.71
23774	" " "	91.96	1.37	1.99	1.13	3.55	0.85	0.52	75.21	0.40	1.89	1.21	5.57	15.72	0.56	0.65	1.93	12.50	1.29
23824	" " "	92.35	1.16	1.71	3.60	1.16	0.85	0.33	82.08	0.55	1.80	1.04	4.80	9.73	0.62	0.42	3.14	5.71	0.88

Station Number.	Sold as	Liquor: Water.	Liquor: Ash.	Liquor: Protein (N x 6.25)	Liquor: Sucrose by Clerget.	Liquor: Undetermined, chiefly Starch.	Liquor: Sodium Chloride.	Liquor: Pea Ash.	Drained Peas: Water.	Drained Peas: Ether Extract.	Drained Peas: Fiber.	Drained Peas: Ash.	Drained Peas: Protein (N x 6.25).	Drained Peas: Nitrogen-free Extract.	Drained Peas: Sodium Chloride.	Drained Peas: Pea Ash.	Drained Peas: Reducing Sugars as Dextrose.	Drained Peas: Starch.	Drained Peas: Undetermined Carbohydrates.
23812	Sifted or Fins	95.59	0.79	1.17	1.60	0.85	0.55	0.24	83.66	0.20	1.69	0.74	3.58	10.13	0.34	0.40	0.90	7.54	1.69
23788	" " "	92.20	0.87	1.20	4.30	1.43	0.61	0.26	80.74	0.71	1.92	0.97	4.49	11.17	0.55	0.42	4.06	5.98	1.13
23755	" " "	94.18	0.84	0.66	3.09	1.23	0.64	0.20	82.21	0.20	1.69	0.90	3.53	11.47	0.45	0.45	2.95	7.39	1.13
23959	" " "	92.54	0.92	1.98	2.38	2.18	0.56	0.36	86.25	0.37	1.35	0.90	3.92	7.21	0.47	0.43	2.79	3.32	1.10
23795	" " "	93.70	1.28	1.61	2.27	1.14	0.94	0.34	79.72	0.71	1.87	1.16	5.38	11.16	0.71	0.45	2.28	6.83	2.05
23806	" " "	93.77	0.85	1.63	3.07	0.68	0.54	0.31	84.25	0.47	1.63	0.77	4.86	8.02	0.29	0.48	2.66	4.40	0.96
23772	Early June Sifted	94.56	1.33	1.63	1.52	0.96	0.96	0.37	80.66	0.36	1.75	1.16	4.34	11.73	0.68	0.48	1.41	9.63	0.69
23787	" " "	93.51	1.06	2.16	1.95	1.32	0.72	0.34	80.77	0.37	1.66	0.98	4.73	11.49	0.51	0.47	2.01	8.43	1.05
23778	" " "	94.34	1.28	1.61	1.58	1.19	0.91	0.37	78.32	0.39	1.80	1.17	4.79	13.53	0.69	0.48	1.48	10.99	1.06
23790	" " "	93.59	1.05	1.74	2.50	1.12	0.68	0.37	75.68	0.40	1.88	0.91	5.24	15.89	0.48	0.43	2.06	12.28	1.55
23834	Early June	92.68	1.22	1.60	1.06	3.44	0.88	0.34	83.41	0.60	1.61	1.11	4.45	8.82	0.70	0.41	2.37	4.98	1.47
23945	" "	93.85	1.26	1.81	1.11	1.97	0.79	0.47	74.76	0.38	2.04	1.08	5.78	15.96	0.49	0.59	0.48	13.66	1.82
23954	" "	92.37	1.37	1.53	3.49	1.24	1.03	0.34	80.19	0.57	1.62	1.18	5.47	10.97	0.69	0.49	2.27	7.15	1.55
23821	" "	92.10	1.81	2.15	1.14	2.80	1.25	0.56	73.97	0.38	2.08	1.50	5.95	16.12	0.86	0.64	0.60	13.24	2.28
23803	" "	93.65	0.84	1.51	2.45	1.55	0.52	0.32	82.49	0.56	1.85	0.80	4.87	9.43	0.35	0.45	2.70	5.63	1.10
23950	" "	94.37	1.04	1.32	0.00	3.27	0.79	0.25	86.18	0.42	1.51	0.89	3.80	7.20	0.54	0.35	2.58	3.77	0.85
23796	" "	93.29	1.24	1.33	2.77	1.37	0.99	0.25	78.24	0.43	1.83	1.13	4.33	14.04	0.70	0.43	3.11	10.05	0.88
23955	" "	91.67	1.33	1.90	2.73	2.37	0.94	0.39	76.34	0.59	1.72	1.13	5.17	15.05	0.64	0.49	1.95	11.75	1.35
23736	" "	92.41	1.62	1.91	2.80	1.26	1.05	0.57	76.20	0.29	1.94	1.32	4.93	15.32	0.75	0.57	0.78	13.32	1.22
23944	" "	92.20	1.56	2.02	0.69	3.53	1.02	0.54	78.19	0.34	1.73	1.32	4.92	13.50	0.72	0.60	0.58	10.79	2.13
23832	" "	92.84	1.53	1.01	0.45	4.17	0.97	0.56	77.29	0.36	2.00	1.28	5.00	14.07	0.66	0.62	0.53	11.82	0.72
23797	" "	95.11	1.80	1.33	1.18	0.58	1.40	0.40	75.29	0.38	1.98	1.40	5.60	15.35	0.94	0.46	0.37	13.34	1.64
22784	" "	93.94	2.16	1.66	0.30	1.94	1.73	0.43	75.23	0.38	1.96	1.69	5.89	14.85	1.12	0.57	0.34	12.51	2.00
23792	" "	92.58	1.20	1.45	3.00	1.77	0.86	0.34	78.87	0.64	2.08	1.20	5.24	11.97	0.62	0.58	3.23	6.75	1.99
23761	" "	92.38	1.07	1.56	3.00	1.99	0.69	0.38	72.83	0.45	2.07	0.99	5.08	18.58	0.46	0.53	2.69	14.42	1.47
23937	" "	92.98	1.82	1.70	1.96	1.54	1.29	0.53	79.22	0.33	1.82	1.43	4.57	12.63	0.92	0.51	1.18	10.21	1.24
23957	" "	93.84	1.03	2.22	0.35	2.56	0.52	0.51	75.58	0.42	1.98	0.93	6.45	14.64	0.32	0.61	0.56	12.83	1.25
23789	" "	94.00	1.18	1.93	1.17	1.72	0.68	0.50	75.20	0.38	1.89	1.04	5.77	15.72	0.38	0.66	0.53	13.17	2.02
23745	" "	94.19	1.30	1.69	2.20	0.62	0.82	0.48	73.82	0.42	2.07	1.16	5.37	17.16	0.49	0.67	0.67	15.65	0.84

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Liquor. Water.	Ash.	Protein (N x 6.25).	Sucrose by Clerget.	Undetermined, chiefly Starch.	Sodium Chloride.	Pea Ash.	Drained Peas. Water.	Ether Extract.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract.	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose.	Starch.	Undetermined Carbohydrates.
23744	Early June	93.25	1.46	1.48	2.50	1.31	1.04	0.42	76.86	0.71	2.07	1.32	6.16	12.88	0.75	0.57	2.52	9.14	1.22
23735	Marrow Sifted	92.17	1.82	2.13	2.13	1.75	1.18	0.64	74.31	0.31	1.83	1.42	5.71	16.42	0.80	0.62	0.91	14.43	1.08
23822	" "	94.87	1.11	1.45	1.42	1.15	0.78	0.33	81.27	0.54	2.02	1.11	4.91	10.15	0.57	0.54	1.51	6.82	1.82
23737	" "	94.95	1.08	1.45	1.83	0.69	0.66	0.42	79.23	0.70	2.05	1.01	5.69	11.32	0.48	0.53	1.29	8.81	1.22
23810	" "	95.08	1.12	1.42	1.26	1.12	0.79	0.33	80.84	0.56	2.03	1.05	4.03	11.49	0.54	0.51	1.11	6.96	3.42
23753	Marrow	90.13	1.15	2.38	4.84	1.50	0.65	0.50	74.32	0.38	1.96	1.14	5.80	16.40	0.36	0.78	3.15	12.46	0.79
23739	"	94.26	1.31	1.94	1.82	0.67	0.90	0.41	74.75	0.32	1.94	1.25	5.84	15.90	0.73	0.52	0.67	14.27	0.96
23946	Telephone	91.18	1.21	1.86	3.46	2.29	0.84	0.37	81.21	0.55	1.64	1.04	5.11	10.45	0.60	0.44	3.47	5.94	1.04
23765	"	91.08	1.12	1.84	4.63	1.33	0.79	0.33	82.83	0.52	1.69	1.12	4.23	9.61	0.70	0.42	4.93	3.72	0.96
23780	"	92.57	1.04	0.98	4.28	1.13	0.72	0.32	82.31	0.68	1.88	1.10	3.71	10.32	0.49	0.61	3.73	5.29	1.30
23805	"	93.58	1.49	1.20	2.84	0.89	1.24	0.25	84.33	0.48	1.70	1.33	4.05	8.11	0.95	0.38	2.87	4.28	0.96
23928	"	92.33	1.52	1.87	0.82	3.46	0.98	0.54	77.97	0.36	1.71	1.22	4.64	14.10	0.62	0.60	0.82	11.38	1.90
23766	"	93.29	1.16	2.01	1.66	1.88	0.82	0.34	76.22	0.69	2.04	1.08	6.32	13.65	0.60	0.48	1.76	9.73	2.16
23833	Sweet Wrinkled	91.76	0.95	1.31	3.48	2.50	0.63	0.32	84.08	0.45	1.52	0.93	3.91	9.11	0.51	0.42	4.19	4.09	0.83
23830	" "	92.15	1.19	1.80	3.82	1.04	0.81	0.38	81.02	0.58	1.67	1.05	5.24	10.44	0.54	0.51	3.17	6.03	1.24
23776	" "	94.63	0.68	1.48	1.92	1.29	0.36	0.32	79.44	0.62	2.03	0.73	5.67	11.51	0.21	0.52	1.90	7.82	1.79
23738	" "	93.47	1.03	1.48	2.88	1.14	0.71	0.32	80.42	0.58	1.91	1.00	5.10	10.99	0.48	0.52	2.80	6.69	1.50
23764	" "	91.23	1.22	1.51	5.21	0.83	0.93	0.29	82.17	0.62	1.90	1.17	4.16	9.98	0.76	0.41	5.18	4.06	0.74
23929	" "	93.52	0.94	1.29	3.31	0.94	0.61	0.33	83.08	0.64	1.58	0.89	4.57	9.24	0.46	0.43	2.99	5.32	0.93
23831	" "	92.92	1.02	1.01	1.78	3.27	0.75	0.27	87.21	0.40	1.43	0.89	3.10	6.97	0.59	0.30	2.81	3.34	0.82
23740	" "	94.47	1.19	1.49	1.52	1.33	0.82	0.37	76.52	0.69	2.04	1.11	6.08	13.56	0.58	0.53	1.57	9.92	2.07
23801	" "	92.75	1.57	1.77	2.00	1.91	1.16	0.41	77.11	0.58	2.16	1.44	5.96	12.75	0.86	0.58	1.75	8.76	2.24
23823	" "	92.28	1.22	1.43	3.93	1.14	0.93	0.29	83.30	0.53	1.72	1.08	3.89	9.48	0.71	0.37	3.40	4.67	1.41
23746	" "	94.70	0.87	1.17	2.19	1.07	0.66	0.21	80.71	0.68	2.08	0.95	4.86	10.72	0.52	0.43	1.30	6.73	2.69
23828	" "	92.73	1.08	1.68	1.52	2.99	0.70	0.38	80.50	0.58	1.88	0.99	5.30	10.75	0.43	0.56	2.65	6.48	1.62
23743	" "	92.29	0.97	1.18	4.62	0.94	0.70	0.27	81.69	0.60	1.50	0.89	4.11	11.21	0.41	0.48	4.37	5.49	1.35
23734	" "	92.29	0.92	1.33	4.31	1.15	0.62	0.30	83.03	0.62	1.75	0.88	4.13	9.59	0.50	0.38	4.43	4.18	0.98
23786	Sweet or Sugar	93.41	0.98	1.65	2.55	1.41	0.65	0.33	77.30	0.61	2.03	0.97	5.96	13.13	0.42	0.55	2.09	8.53	2.51

TABLE III.—CHEMICAL ANALYSES OF CANNED PEAS—*Continued.*

Station Number.	Sold as	Liquor.							Drained Peas.										
		Water.	Ash.	Protein (N x 6.25).	Sucrose by Clerget.	Undetermined, chiefly Starch.	Sodium Chloride.	Pea Ash.	Water.	Ether Extract.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract.	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose	Starch.	Undetermined Carbohydrates.
23939	Sweet or Sugar	93.13	1.00	1.63	2.91	1.33	0.66	0.34	83.03	0.49	1.76	0.92	4.69	9.11	0.49	0.43	2.61	5.28	1.22
23930	" " "	91.41	0.92	1.74	4.91	1.02	0.59	0.33	83.00	0.46	1.69	0.92	4.38	9.55	0.49	0.43	4.08	4.35	1.12
23747	" " "	91.46	1.18	1.66	3.04	2.66	0.79	0.39	80.42	0.83	1.84	1.03	5.08	10.80	0.60	0.43	3.57	6.24	0.99
23940	" " "	93.32	0.99	1.64	2.45	1.60	0.60	0.39	80.69	0.49	1.79	0.94	5.55	10.54	0.39	0.55	1.58	6.97	1.99
23799	" " "	92.74	1.02	1.76	3.07	1.41	0.72	0.30	82.14	0.52	1.80	0.97	4.97	9.60	0.57	0.40	3.13	5.54	0.93
23777	" " "	91.13	1.22	1.57	4.86	1.22	0.87	0.35	77.04	0.85	2.00	1.24	5.44	13.43	0.72	0.52	4.94	7.54	0.95
23798	" " "	93.27	1.11	1.67	2.25	1.70	0.75	0.36	78.82	0.63	2.05	1.07	5.84	11.59	0.56	0.51	2.40	7.68	1.51
23775	" " "	93.98	0.91	1.72	2.59	0.80	0.65	0.26	84.73	0.49	1.66	0.95	4.15	8.02	0.47	0.48	2.77	4.37	0.68
23813	" " "	92.11	1.19	1.81	3.51	1.38	0.84	0.35	82.33	0.51	1.78	1.09	4.72	9.57	0.66	0.43	2.74	5.16	1.67
23804	" " "	91.96	1.07	1.90	3.39	1.68	0.71	0.36	81.11	0.67	1.74	1.11	4.82	10.55	0.65	0.46	4.07	5.51	0.97
23820	Peas	93.05	1.14	1.79	2.84	1.18	0.77	0.37	76.52	0.40	1.80	1.01	5.52	14.75	0.50	0.51	2.31	11.45	0.99
23941	"	92.64	1.20	1.97	2.43	1.76	0.81	0.39	78.52	0.35	1.75	0.99	4.98	13.41	0.53	0.46	2.67	9.15	1.59
23754	"	93.72	1.16	1.51	2.48	1.13	0.76	0.40	76.90	0.76	2.02	1.12	6.32	12.88	0.46	0.66	2.00	8.39	2.49
23733	"	94.61	0.95	1.10	2.17	1.17	0.72	0.23	81.19	0.65	1.90	0.91	4.85	10.50	0.54	0.37	2.32	7.42	0.76
23953	"	94.34	1.05	1.12	1.98	1.51	0.82	0.23	86.06	0.43	1.64	1.00	3.72	7.15	0.62	0.38	2.74	3.29	1.12
23748	"	92.82	1.17	1.35	3.04	1.62	0.94	0.23	79.83	0.38	1.75	1.20	4.00	12.84	0.69	0.51	3.27	8.62	0.95
23759	"	93.84	1.46	1.51	1.22	1.97	0.95	0.51	76.63	0.38	1.93	1.26	4.92	14.88	0.66	0.60	0.93	12.41	1.54
23817	"	94.16	1.05	1.46	2.13	1.20	0.77	0.28	83.69	0.65	1.67	0.98	4.40	8.61	0.62	0.36	2.51	4.91	1.19
23779	"	93.70	0.93	1.48	2.73	1.16	0.69	0.24	85.16	0.62	1.51	1.01	4.01	7.69	0.57	0.44	3.14	3.92	0.63
23819	"	92.43	1.13	1.46	3.43	1.55	0.84	0.29	84.51	0.51	1.43	1.02	4.15	8.38	0.63	0.39	3.49	4.06	0.83
23800	June	95.12	0.76	1.74	1.51	0.87	0.48	0.28	80.24	0.38	1.50	0.59	4.67	12.62	0.20	0.39	0.89	10.95	0.78
23942	"	89.32	1.32	3.04	0.92	5.40	0.71	0.61	77.32	0.33	1.84	1.14	5.52	13.85	0.51	0.63	0.50	11.31	2.04
23927	Medium	96.23	0.49	1.12	1.51	0.65	0.23	0.26	80.49	0.36	2.02	0.57	4.54	12.02	0.09	0.48	1.28	9.79	0.95
23958	Selected	94.96	1.03	1.01	2.13	0.87	0.79	0.24	87.10	0.48	1.02	1.00	2.93	7.47	0.67	0.33	1.89	3.44	2.14
23938	Small Tender	92.80	1.23	1.90	3.20	0.87	0.92	0.31	86.65	0.32	1.36	1.05	3.68	6.94	0.67	0.38	2.66	3.45	0.83
	Maximum	*96.27*	*2.16*	*3.04*	*5.21*	*5.40*	*1.73*	*0.64*	*90.46*	*0.85*	*2.08*	*1.69*	*6.45*	*18.58*	*1.12*	*0.78*	*5.18*	*15.65*	*3.42*
	Minimum	*89.32*	*0.49*	*0.66*	*0.00*	*0.21*	*0.23*	*0.19*	*72.83*	*0.14*	*0.94*	*0.52*	*2.52*	*4.75*	*0.09*	*0.30*	*0.34*	*2.04*	*0.09*
	Average	*93.33*	*1.15*	*1.55*	*2.44*	*1.53*	*0.81*	*0.34*	*80.86*	*0.46*	*1.77*	*1.06*	*4.62*	*11.23*	*0.58*	*0.48*	*2.26*	*7.64*	*1.33*

TABLE IV.—CHEMICAL ANALYSES OF DRAINED PEAS (WATER-FREE BASI

Station No.	Sold as	Total Dry Matter per Can.	Ether Extract.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free Extract.	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose.	Starch.	Undetermined
		gms.	%	%	%	%	%	%	%	%	%	%
23936	Petits Pois	35	2.05	10.71	5.28	25.75	56.21	2.13	3.15	15.20	30.55	10.
23815	" "	49	1.95	9.52	9.30	21.59	57.66	6.67	2.63	20.84	31.03	5.
23947	" "	29	3.57	11.06	6.48	23.80	55.09	3.71	2.77	21.54	25.04	8.
23949	" "	46	1.86	11.38	5.75	22.47	58.54	2.82	2.93	12.52	39.25	6.
23816	" "	53	1.20	10.98	6.28	23.93	57.61	3.72	2.56	4.54	46.67	6.
23825	" "	54	1.15	10.28	6.56	22.26	59.75	3.94	2.62	4.38	47.21	8.
23809	" "	30	2.37	10.22	7.48	21.58	58.35	4.68	2.80	13.67	37.63	7.
23826	" "	54	1.80	10.06	7.79	21.12	59.23	5.13	2.66	17.52	37.04	4.
23814	" "	53	2.10	9 75	7.95	23.27	56.93	5.49	2 46	14.16	34.47	8.
23750	Petits Pois Extra Fins	46	1.07	11.43	6.46	27.96	52.18	3.54	2.92	12.38	31.50	8.
23749	Petits Pois Fins	50	1.33	10.97	7.14	22.59	57.97	4.48	2.66	10.18	40.97	6.
23793	" " "	45	1.28	11.91	5.71	22.31	58.79	3.34	2.37	8.63	41.28	8.
23808	" " "	49	1.21	11.22	6.04	23.30	58.23	3.16	2.88	4.83	45.05	8.
23807	Extra Fins or Extra Sifted	27	1.93	10.64	4.77	23.12	59.54	2.20	2.57	24.49	24.77	10.
23752	" " " "	54	3.32	12.04	7.57	27.32	49.75	4.80	2.77	13.46	28.26	8.
23956	" " " "	62	3.59	10.31	6.21	24.34	55.55	4.10	2.11	14.41	31.65	9.
23791	" " " "	39	1.21	10.42	6.14	24.88	57.35	3.31	2.83	16.72	31.66	8.
23773	Early June Extra Sifted	79	1.71	8.42	5.37	22.26	62.24	2.96	2.41	9.67	47.99	4
23932	" " " "	38	3.14	9.85	7.44	29.77	49.80	4.30	3.14	15.30	21.38	13.
23756	Sifted or Fins	99	1.62	7.40	5.32	21.57	64.09	3.16	2.16	10.85	48.79	4.
23931	" " "	44	0.77	10.08	7.78	21.81	59.56	4.99	2.79	2.90	47.07	9.
23785	" " "	93	1.83	7.72	4.71	19.93	65.81	2.38	2.33	15.49	40.40	9.
23751	" " "	71	2.65	10.29	4.28	25.34	57.44	1.90	2.38	25.34	31.62	0.
23760	" " "	74	2.67	10.04	7.17	27.46	52.66	4.85	2.32	14.49	30.63	7.
23811	" " "	89	1.81	8.56	6.10	18.43	65.10	3.58	2.52	12.24	45.51	7.
23943	" " "	60	3.80	9.86	5.61	22.63	58.10	3.03	2.58	23.79	27.47	6.
23802	" " "	64	2.10	8.92	5.07	19.01	64.90	2.56	2.51	20.35	40.41	4.
23774	" " "	103	1.61	7.62	4.88	22.47	63.42	2.26	2.62	7.79	50.42	5.
23824	" " "	63	3.07	10.04	5.80	26.79	54.30	3.46	2.34	17.52	31.86	4.
23812	" " "	46	1.22	10.34	4.53	21.91	62.00	2.08	2.45	5.51	46.14	10.
23788	" " "	71	3.69	9.97	5.04	23.31	57.99	2.85	2.19	21.08	31.05	5.
23755	" " "	52	1.12	9.50	5.06	19.84	64.48	2.53	2.53	16.58	41.54	6.
23959	" " "	49	2.69	9.82	6.55	28.51	52.43	3.42	3.13	20.29	24.15	7.
23795	" " "	78	3.50	9.22	5.72	26.53	55.03	3.50	2.22	11.24	33.68	10.
23806	" " "	59	2.98	10.35	4.89	30.86	50.92	1.84	3.05	16.89	27.94	6.
23772	Early June Sifted	78	1.86	9.05	6.00	22.44	60.65	3.52	2.48	7.29	49.79	3.
23787	" " "	77	1.92	8.63	5.10	24.60	59.75	2.65	2.45	10.45	43.84	5.
23778	" " "	83	1.80	8.30	5.40	22.09	62.41	3.18	2.22	6.83	50.69	4.
23790	" " "	84	1.64	7.73	3.74	21.55	65.34	1.97	1.77	8.47	50.49	6.
23834	Early June	65	3.62	9.70	6.69	26.82	53.17	4.22	2.47	14.29	30.02	8.
23945	" "	94	1.51	8.08	4.28	22.90	63.23	1.94	2.34	1.90	54.12	7.
23954	" "	73	2.88	8.18	5.96	27.61	55.32	3.48	2.48	11.46	36.09	7.
23821	" "	96	1.46	7.99	5 76	22.86	61.93	3.30	2.46	2.31	50.86	8.7
23803	" "	66	3.20	10.57	4 57	27.81	53.85	2.00	2.57	15.42	32.15	6.2
23950	" "	51	3.04	10.93	6.44	27.50	52.09	3.91	2.53	18.67	27.28	6.1
23796	" "	78	1.98	8.41	5.19	19.90	64.52	3.22	1.97	14.29	46.18	4.0
23955	" "	90	2.49	7.27	4.78	21.85	63.61	2.70	2.08	8.24	49.66	5.7
23736	" "	95	1.22	8.15	5.55	20.71	64.37	3.15	2.40	3.28	55.97	5.1
23944	" "	90	1.56	7.93	6.05	22.56	61.90	3.30	2.75	2.66	49.47	9.7
23832	" "	82	1.59	8.81	5.64	22.02	61.94	2.91	2.73	2.33	52.05	7.5
23797	" "	76	1.54	8.01	5.67	22.66	62.12	3.80	1.87	1.50	53.99	6.6
23784	" "	82	1.53	7.91	6.82	23.78	59.96	4.52	2.30	1.37	50.50	8.0
23792	" "	78	3.03	9.84	5.68	24.80	56.65	2.93	2.75	15.29	31.94	9.4
23761	" "	103	1.66	7.62	3.64	18.70	68.38	1.69	1.95	9.90	53.07	5 4
23937	" "	80	1.59	8.76	6.88	21.99	60.78	4.43	2.45	5.68	49.13	5.9

TABLE IV.—CHEMICAL ANALYSES OF DRAINED PEAS (WATER-FREE BASIS)
—*Continued.*

Station No.	Sold as	Total Dry Matter per Can.	Ether Extract.	Fiber.	Ash	Protein (N x 6.25).	Nitrogen-free Extract	Sodium Chloride.	Pea Ash.	Reducing Sugars as Dextrose.	Starch.	Undetermined Carbohydrates.
		gms.	%	%	%	%	%	%	%	%	%	%
23745	Early June	101	1.60	7.91	4.43	20.51	65.55	1.87	2.56	2.56	59.78	3.21
23744	" "	85	3.07	8.95	5.70	26.62	55.66	3.24	2.46	10.89	39.07	5.70
23735	Marrow Sifted	117	1.21	7.12	5.53	22.23	63.91	3.11	2.42	3.54	56.17	4.20
23822	" "	71	2.88	10.78	5.93	26.21	54.20	3.04	2.89	8.06	36.41	9.73
23737	" "	77	3.37	9.87	4.86	27.40	54.50	2.31	2.55	6.21	42.42	5.87
23810	" "	71	2.92	10.60	5.48	21.03	59.97	2.82	2.66	5.79	36.33	17.85
23753	Marrow	108	1.48	7.63	4.44	22.59	63.86	1.40	3.04	12.27	48.52	3.07
23739	"	101	1.27	7.68	4.95	23.13	62.97	2.89	2.06	2.65	56.51	3.81
23946	Telephone	77	2.93	8.73	5.53	27.20	55.61	3.19	2.34	18.47	31.61	5.53
23765	"	71	3.03	9.84	6.52	24.64	55.97	4.08	2.44	28.71	21.67	5.59
23780	"	64	3.84	10.63	6.22	20.97	58.34	2.77	3.45	21.09	29.90	7.35
23805	"	55	3.06	10.85	8.49	25.85	51.75	6.06	2.43	18.32	27.31	6.12
23928	"	90	1.63	7.76	5.54	21 06	64.01	2.81	2.73	3.72	51.66	8.63
23766	"	88	2.90	8.58	4.54	26.59	57.39	2.52	2.02	7.40	40.92	9.07
23833	Sweet Wrinkled	62	2.83	9.55	5.84	24.56	57.22	3.20	2.64	26.32	25.69	5.21
23830	" "	72	3.06	8.80	5.53	27.61	55.00	2.85	2.68	16.70	31.77	6.53
23776	" "	71	3.02	9.87	3.55	27.58	55.98	1.02	2.53	9.24	38.04	8.70
23738	" "	71	2.96	9.75	5.11	26.05	56.13	2.45	2.66	14.30	34.17	7.66
23764	" "	65	3.48	10.66	6.56	23.33	55.97	4.26	2.30	29.05	22.77	4.15
23929	" "	59	3.78	9.34	5.26	27.01	54.61	2.72	2.54	17.67	31.44	5.50
23831	" "	51	3.13	11.18	6.96	24.24	54.49	4.61	2.35	21.97	26.11	6.41
23740	" "	86	2.94	8.69	4.73	25.89	57.76	2.47	2.26	6.69	42.25	8.82
23801	" "	82	2.53	9.44	6.29	26.04	55.70	3.76	2.53	7.65	38.27	9.78
23823	" "	63	3.17	10.30	6.47	23.29	56.77	4.25	2.22	20.36	27.96	8.45
23746	" "	70	3.53	10.78	4.92	25.19	55.58	2.70	2.22	6.74	34.89	13.92
23828	" "	79	2.97	9.64	5.08	27.18	55.13	2.21	2.87	13.56	33.23	8.34
23743	" "	72	3.28	8.19	4.86	22.45	61.22	2.24	2.62	23.87	30.00	7.35
23734	" "	63	3.65	10.31	5.18	24.34	56.52	2.95	2.23	26.10	24.63	5.79
23786	Sweet or Sugar	90	2.69	8.94	4.27	26.26	57.84	1.85	2.42	9.21	37.58	11.05
23939	" " "	67	2.89	10.37	5.42	27.64	53.68	2.89	2.53	15.38	31.11	7.19
23930	" " "	72	2.71	9.94	5.41	25.76	56.18	2.88	2.53	24.00	25.59	6.59
23747	" " "	77	4.24	9.40	5.26	25.95	55.15	3.06	2.20	18.23	31.87	5.05
23940	" " "	67	2.54	9.27	4.87	28.74	54.58	2.02	2.85	8.18	36.10	10.30
23799	" " "	72	2.91	10.08	5.43	27.83	53.75	3.19	2.24	17.53	31.02	5.20
23777	" " "	90	3.70	8.71	5.40	23.69	58.50	3.14	2.26	21.52	32.84	4.14
23798	" " "	85	2.97	9.68	5.05	27.57	54.73	2.64	2.41	11.33	36.26	7.14
23775	" " "	58	3.21	10.87	6.22	27.18	52.52	3.08	3.14	18.14	28.62	5.76
23813	" " "	69	2.89	10.07	6.17	26.71	54.16	3.74	2.43	15.51	29.20	9.45
23804	" " "	73	3.55	9.21	5.88	25.52	55.84	3.44	2.44	21.55	29.17	5.12
23820	Peas	90	1.70	7.67	4.30	23.51	62.82	2.13	2.17	9.84	48.76	4.22
23941	"	81	1.63	8.15	4.61	23.18	62.43	2.47	2.14	12.43	42.60	7.40
23754	"	84	3.29	8.74	4.85	27.36	55.76	1.99	2.86	8.66	36.32	10.78
23733	"	69	3.46	10.10	4.84	25.78	55.82	2.87	1.97	12.33	39.45	4.04
23953	"	49	3.08	11.76	7.17	26.69	51.30	4.45	2.72	19.66	23.60	8.04
23748	"	79	1.88	8.68	5.95	19.83	63.66	3.42	2.53	16.21	42.74	4.71
23759	"	86	1.63	8.26	5.39	21.05	63 67	2.82	2.57	3.98	53.10	6.59
23817	"	61	3.99	10.24	6.01	26.98	52.78	3.80	2.21	15.39	30.10	7.29
23779	"	54	4.18	10.18	6.81	27.02	51.81	3.84	2.97	21.16	26.42	4.23
23819	"	58	3.29	9.23	6.58	26.79	54.11	4.07	2.51	22.53	26.21	5.37
23800	June	73	1.92	7.59	2.99	23.63	63.87	1.01	1.98	4.50	55.41	3.96
23942	"	90	1.46	8.11	5.03	24.34	61.06	2.25	2.78	2.20	49.87	8.99
23927	Medium	53	1.84	10.35	2.92	23.27	61.62	0.46	2.46	6.56	50.18	4.88
23958	Selected	48	3.72	7.91	7.75	22.71	57.91	5.19	2.56	14.65	26.67	16.59
23938	Small Tender	46	2.40	10.19	7.87	27.57	51.97	5.02	2.85	19.93	25.84	6.20
	Maximum	*117*	*4.24*	*11.91*	*9.30*	*30.86*	*68.38*	*6.67*	*3.45*	*28.71*	*59.78*	*17.85*
	Minimum	*27*	*0.77*	*7.12*	*2.92*	*18.43*	*49.75*	*0.46*	*1.77*	*1.37*	*21.38*	*0.48*
	Average	*70*	*2.40*	*9.25*	*5.54*	*24.14*	*58.67*	*3.03*	*2.51*	*11.81*	*39.92*	*6.94*

table, but, in the great majority of households this liquor is entirely wasted. In the samples examined the liquor made up from 27 to 49.7 per cent. of the total weight of the can contents, with an average of 36.1 per cent. It is, therefore, of importance to learn just how much nutriment this discarded liquor contains. In our examination water, ash, protein, sucrose, sodium chloride and glucose were determined directly, and starch by difference.

The analysis of the liquor may be summarized as follows:

	Max.	*Min.*	*Ave.*
Water	96.27	89.32	93.33
Ash	2.16	0.49	1.15
Protein	3.04	0.66	1.55
Sucrose	5.21	0.00	2.44
Undetermined, chiefly starch	5.40	0.21	1.53
Sodium chloride	1.73	0.23	0.81
Sodium chloride—free ash	0.64	0.19	0.34

In other words, the composition of the liquor is exceedingly variable. No striking differences in composition are shown between the liquors of the peas of different grades, although in the "petits pois" the percentages of ash, protein and starch are somewhat lower than in the liquor of the more matured peas.

The solid matter of the liquor ranges from 3.73 to 10.68 per cent. This is made up on the average of 23 per cent. protein, 37 per cent. sugar, 23 per cent. starch, 5 per cent. pea ash and 12 per cent. sodium chloride.

The following tabulation shows the average composition of the solids of the drained peas and the liquor of the 111 samples per can:

	206 grams of Liquor contain		364 grams of Drained Peas contain	
Ash	2.37 gms.	= 38% of total.	3.86 gms.	= 62% of tota
Protein	3.19 "	= 16% " "	16.82 "	= 84% " "
Carbohydrates	8.18 "	= 15% " "	47.32 "	= 85% " "
Fat	---	---	1.67 "	= 100% " "
Total Solids	13.74 "	= 16% " "	69.67 "	= 84% " "

That is, 16 per cent. of the total solids of the canned peas is represented in the discarded liquor. This quantity, however, does not necessarily mean that much loss of pea substance, for sugar is often added to sweeten otherwise insipid peas and salt is added for seasoning purposes. The 10 per cent. loss of starch and 16 per cent. loss of protein are, however, actual loss of pea substance, and represent a distinct waste of food. These losses

are due in part to methods of canning, too little liquor causing mushiness in the peas and consequently a thick, cloudy liquor. Even with the best methods of canning, however, the liquor must continue to represent considerable waste, unless the processes can be so improved as to eliminate or reduce the odor of the liquor, which is disagreeable to many, and ensure a nearly clear liquor free of excessive starch. The solubility of a portion of the pea protein in water and weak sodium chlorid solutions seems to present a chemical problem difficult to solve. If, however, the present objectionable features of the liquor can be removed and its use made admissible, this loss of protein becomes entirely a matter of household economics.

The liquor was not examined for metallic contamination, for while certain of the tin and copper salts may he present in the liquor, the fact that the liquor is rarely used as food makes their determination of relative unimportance. Tin, copper and lead were determined in the drained peas and will be discussed later in this report.

In eight of the samples in which sugar was declared on the label, glucose was present; in one of these cane sugar was specifically guaranteed, and this sample was clearly misbranded.

In fifty-six of the samples a plus reading was obtained after inversion, indicating the possible addition of glucose syrup. Calculated as glucose this ranged from 0.27 to 1.30 per cent., with an average of 0.47 per cent.

The Drained Peas.

Below will be found the average analysis of 20 samples of fresh peas by Dubois,* the average analysis of 81 samples of

	Fresh Peas. (Dubois.)		Canned Peas. (Peas and Liquor.) (McElroy and Bigelow.)		(Connecticut.)		Drained Peas. (Connecticut.)		Liquor. (Connecticut.)
	Original.	Water-free.	Original.	Water-free.	Original.	Water-free.	Original.	Water-free.	Original.
Water	74.97	....	85.48	....	85.37	...	80.86	....	93.33
Ether Extract	0.34	1.35	0.21	1.45	0.29	1.98	0.46	2.40	....
Fiber	2.26	8.96	1.18	8.13	1.13	7.72	1.77	9.25	....
Ash	0.91	3.61	1.11	7.64	1.09	7.45	1.06	5.54	1.15
Protein	6.88	28.13	3.56	24.52	3.51	24.00	4.62	24.14	1.55
Nitrogen-free Ex.	14.64	57.95	8 46	58.26	8.61	58.85	11.23	58.67	3.97
Nitrogen	1.10	4.50	0.57	3.93	0.56	3.83	0.74	3.86	0.25
Sodinm Chloride	...	....	0.66	4.55	0.66	4.51	0.58	3.03	0.81
Pea Ash	0.91	3.61	0.45	3.09	0.43	2.94	0.48	2.51	0.34

* U. S. Dept. Agr., Bur. of Chem., Circ. 54.

canned peas (peas and liquor) by McElroy & Bigelow* and the average analysis of our 111 samples (peas, liquor and peas and liquor combined), both in the original material and on the water-free basis.

It appears from the above figures that during canning the peas take up on the average about 8 per cent. of water. The most important changes, however, are in the ash and protein. The ash has increased from 3.61 per cent. in the fresh peas to 5.54 per cent. in the drained peas, water-free basis, on account of the added sodium chloride, 3.03 per cent., the true pea ash showing a loss of 1.10 per cent. The protein has decreased from 28.13 to 24.14 per cent., the loss chiefly occurring during the washing and the blanching of the peas.

The close agreement of the analyses made seventeen years ago by the Bureau of Chemistry and by this laboratory in the present year is quite remarkable. The averages probably represent accurately the composition of canned peas sold in the American market. McElroy and Bigelow's samples represent forty-three of American and thirty-eight of foreign origin, while of our samples ninety-seven were packed in America and fourteen in foreign countries.

The samples showed wide variations in composition in all ingredients, both in the fresh and water-free condition. These variations are due to differences in the methods of canning, in maturity of the peas, in seasoning and sweetening used and in the amount of water added. Dubois† has shown that as the pea matures the ash and crude fiber decrease, and the starch increases, as a rule, while variety and locality appear to have more influence on the protein content. The crude fiber of immature peas, in which the meaty portion has just begun to develop, is usually higher than in the more mature.

In seventy-one of the samples examined the label indicated a distinct classification, based on size. The following table shows the amount of nutriment offered to the consumer under these different group names.

In the original substance it will be noted that the smaller peas have much more water than the larger sizes; for instance, the

* U. S. Dept. Agr., Bur. of Chem., Bull. 13, pt. 8, p. 1094.

† *Loc. cit.*

COMPOSITION OF DRAINED PEAS. (In Original Substance.)

	No.	Water.	Fat.	Fiber.	Ash.	Protein.	Extract.	NaCl.	Sugar.	Starch.	Undetermined Carbohydrates.
Petits Pois	9	84.91	.29	1.58	1.05	3.45	8.72	.64	1.99	5.64	1.09
Petits Pois Extra Fins	1	85.30	.29	1.68	0.95	4.11	7.67	.52	1.82	4.63	1.22
Petits Pois Fins	3	82.47	.22	1.99	1.11	3.98	10.23	.65	1.39	7.44	1.40
Extra Fins, or Extra Sifted	4	86.58	.35	1.46	0.84	3.36	7.41	.50	2.25	3.94	1.23
Early June Extra Sifted	2	84.41	.34	1.38	0.94	3.83	9.10	.53	1.77	6.21	1.12
Sifted or Fins	16	81.07	.43	1.75	1.04	4.42	11.29	.57	2.79	7.24	1.26
Early June Sifted	4	78.85	.38	1.77	1.06	4.78	13.16	.59	1.74	10.33	1.09
Early June	20	77.51	.45	1.89	1.20	5.24	13.71	.66	1.50	10.76	1.45
Marrow Sifted	4	78.91	.53	1.98	1.15	5.09	12.34	.60	1.20	9.26	1.88
Marrow	2	74.53	.35	1.95	1.20	5.82	16.15	.55	1.91	13.37	0.87
Telephone	6	80.81	.55	1.77	1.15	4.68	11.04	.66	2.93	6.72	1.39

COMPOSITION OF DRAINED PEAS. (Water-free Basis.)

	Dry Matter per Can. gms.	Fat.	Fiber.	Ash.	Protein.	Extract.	NaCl	Sugar.	Starch.	Undetermined Carbohydrates
Petits Pois	45	2.01	10.44	6.98	22.86	57.71	4.25	13.82	36.54	7.35
Petits Pois Extra Fins	46	1.97	11.43	6.46	27.96	52.18	3.54	12.38	31.50	8.30
Petits Pois Fins	48	1.27	11.37	6.30	22.73	58.33	3.66	7.88	42.43	8.02
Extra Fins, or Extra Sifted	45	2.51	10.85	6.17	24.92	55.55	3.60	17.27	29.09	9.19
Early June Extra Sifted	59	2.42	9.13	6.41	26.02	56.02	3.63	12.48	34.69	8.85
Sifted or Fins	70	2.32	9.36	5.53	23.53	59.26	3.02	15.15	37.41	6.70
Early June Sifted	86	1.80	8.43	5.06	22.67	62.04	2.83	8.26	48.70	5.08
Early June	84	2.09	8.54	5.39	23.56	60.42	2.97	7.32	46.35	6.75
Marrow Sifted	84	2.60	9.59	5.45	24.22	58.14	2.82	5.90	42.83	9.41
Marrow	105	1.38	7.65	4.70	22.86	63.41	2.15	7.46	52.51	3.44
Telephone	74	2.90	9.40	6.14	24.38	57.18	3.57	16.29	33.84	7.05

"extra fins" show 86.58 while the "marrow" contain only 74.53 per cent. The variations in the other ingredients appear more strikingly when studied on the water-free basis. The fiber shows a general decrease from 11.43 in "petits pois extra fins" to 7.65 in "marrow." The ash likewise decreases from 6.98 to 4.70. The variations in protein seem to be independent of the class of peas. The sugar shows wide variations, from 5.90 to 17.27, generally being higher in the smaller peas. The opposite is true with starch, "extra fins" containing 29.09 and "marrow" 52.51. The pea ash is very uniform in all classes, but the smaller varieties generally carry somewhat more sodium chloride.

Two common abuses exist in the pea-canning industry, the addition of sugar or glucose syrup to give character to otherwise insipid, sugarless peas, and the use of "soaked" peas. We have already referred to the former in our consideration of the composition of the pea liquor. The sugar in the liquor was found to range from none at all to 5.21 per cent., with an average of 2.44, equivalent to 37 per cent. of the liquor solids. In fifty-six

samples the presence of glucose was also shown, ranging from 0.27 to 1.30 per cent. Total reducing sugars were also determined in the drained peas and are reported in the tables calculated as dextrose. These range from 0.34 to 5.18, average 2.26, per cent. in the original substance, or from 1.37 to 28.71, average 11.81, per cent. in the water-free material.

There is considerable difference of opinion as to the nature of the nitrogen-free extract of fresh peas. R. Sachse* found in 62.70 per cent. of the extract, 42.44 per cent. starch and 6.50 per cent. dextrin. E. Schulze* found in the dry matter 6.22 per cent. of saccharose and galactan, and 40.49 per cent. of starch. König† also gives an analysis with 64.77 per cent. of nitrogen-free extract, with 5.09 per cent. of dextrin and no sugar. As already stated, we did not determine the nature of the sugar present, but only the total reducing sugars calculated as dextrose. Probably the small percentages of undetermined carbohydrates, 0.09 to 3.42 per cent., reported in our tables, consist chiefly of galactan.

On the labels of eighteen samples added sugar is declared, on eight "sugar" is part of the brand name. On twenty-two "sweet" is similarly used, while on the other sixty-three no sugar is declared or any claim made as to superior sweetness. The sugar content of these four groups was as follows in the water-free material:

	Max.	*Min.*	*Ave.*
Added sugar declared	28.71	7.65	14.02
"Sugar" in brand name	24.00	8.18	17.06
"Sweet" in brand name	29.05	6.21	17.77
No reference to sugar on label	24.49	1.37	8.43

While the amount of reducing sugars natural to the pea is somewhat in doubt, it is worthy of note that the minimum percentage of sugar in the dry matter of those samples in which added sugar is declared is 7.65 per cent. It is not unreasonable, therefore, to suspect added sugar in samples showing more than this percentage. Of the sixty-three samples in which no reference to sugar or added sweetening is made on the label, twenty-seven show from 1.37 to 7.79, seven from 8.06 to 11.46, eighteen from 12.27 to 15.42, and eleven from 16.21 to 24.49 per cent. in

* König, Chem. der Mensch. Nahr. u. Genussm., 1904, *2*, 787.

† König, *1*, 636.

the dry matter. The last two classes, numbering twenty-nine samples, certainly contain sugars in amounts exceeding the quantities naturally found in peas. These samples also have excessive amounts of sugar in the pea liquor. Unless the addition of sugar is clearly stated on the label, its use is a deception. The natural sweetness of peas, as of other vegetables, decreases rapidly after picking and with maturity, and the addition of sugar as a rule indicates the use of peas either not freshly picked or over-mature.

Soaked Peas.

In addition to the canning of fresh peas, at certain canneries it is the practice to use dried green or Scotch peas, chiefly grown in Michigan and Wisconsin. These peas are received by the packers dry and after soaking for from twelve to thirty-six hours are blanched, canned and processed in the usual way. It is manifestly misbranding to sell these soaked peas as fresh peas.

The appearance of the peas is of some value in distinguishing soaked from fresh peas. The former are generally more or less broken, the cotyledons are generally more developed, especially in the mature peas, and the liquor is more liable to be thick and starchy. Maturity, however, is not a sure guide, because old and well-developed peas are frequently packed in the fresh condition; and mature fresh peas, over-processed or packed with too little liquor, will give a liquor very similar to that of soaked peas.

Dubois,* in his study of soaked peas, has shown that "it is not hard to distinguish the fresh and more succulent grades from the soaked material, the chief difficulty arising in differentiating between the soaked goods and the more matured peas put up in the usual way." He found the average water content of twenty-two samples of soaked peas to be 72.02, with a maximum of 74.92, and the average for twenty-one samples of mature fresh peas 76.54 per cent., with a minimum of 70.79. This overlapping of results renders impossible a definite conclusion from this determination. Likewise he found the crude starch† in the soaked peas to range from 18.19 to 11.08 per cent., with an average of 13.98, while the average crude starch content of fresh

* *Loc. cit.*

† Includes all carbohydrates hydrolyzed by dilute hydrochloric acid, which reduce copper.

natured peas was 11.05, again an overlapping of results. He found, however, that the average crude starch content of soaked peas was about "4 per cent. higher than that of Early Junes and peas of similar quality."

We found the starch,* in our analyses, to range from 2.04 to 15.65, with an average of 7.64 per cent., in the drained peas, and from 21.38 to 59.78, with an average of 39.92 per cent. in the water-free substance. In the following summary the samples are grouped according to starch content in the fresh material, showing the variations in water content of the drained peas, the solids of the liquor, and the starch of the drained peas in the water-free material.

		In Drained Peas. Original Substance.				Solids in Liquor. Original Substance.			Starch in Drained Peas. Water free Basis.		
			Water.								
ent. rch.	No.	Starch Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
4	13	3.40	90.46	82.83	86.78	8.92	4.69	6.17	31.66	21.38	25.72
5	17	4.43	86.66	82.17	84.29	8.59	5.29	7.09	34.47	22.77	28.20
6	14	5.54	86.10	81.11	82.49	8.82	5.15	7.16	37.63	29.17	31.64
7	14	6.64	83.55	78.87	81.00	8.54	4.16	6.41	41.28	30.63	34.95
8	9	7.56	83.66	77.04	80.71	8.87	3.88	5.98	46.14	32.84	39.19
9	10	8.61	81.75	76.90	79.44	7.79	3.73	6.06	47.21	36.32	41.88
0	7	9.59	80.66	76.22	78.25	7.36	3.77	6.24	50.18	39.07	44.09
1	6	10.56	80.24	78.19	78.77	7.80	4.88	6.41	55.41	46.18	49.74
2	6	11.58	77.97	75.94	76.90	10.68	6.95	8.29	52.05	48.76	50.13
2	15	13.37	76.63	73.82	74.92	8.04	4.89	6.81	59.78	48.52	53.31

The above table shows that on the average there is quite a lose relation between the amount of water and starch in the rained peas and the amount of starch in the liquor. The verage water steadily decreases as the starch increases. Unfor-unately, confirming Dubois's experience, there is an overlapping f results in individual analyses, and the distinction of the soaked rom the fresh peas is far from clear.

Considered from the standpoint of size, in our analyses the ifferent grades showed the following variations in starch, dry asis:

Petits Pois	25.04	to 47.21,	average	37.51
Extra Sifted	21.38	" 47.99,	"	30.95
Sifted	24.15	" 50.69,	"	39.67
Early June	27.28	" 59.78,	"	46.35
Marrow	36.33	" 56.51,	"	46.06
Telephone	21.67	" 51.66,	"	33.85
Unclassified	22.77	" 55.41,	"	38.95

* All water-soluble carbohydrates removed before hydrolysis.

Grouping the samples according to starch content we have thirty containing from 21 to 30 per cent., thirty-eight from 31 to 40 per cent., thirty from 41 to 50 per cent., and thirteen over 50 per cent. Judging from our present information, a sample showing 45 per cent. or more of starch in the dry matter may be suspected to consist of either very mature or soaked peas. We find thirty-five such among our samples. The pea liquor of three of these was slightly cloudy, of eleven cloudy, of sixteen thick and of five very thick: in nine of them the consistency of the peas was good, in twenty-three they were hard, and in three were soft; the cotyledons were prominent in twenty-two, not prominent in eleven and of varying prominence in two. Accepting as characteristics of soaked peas a thick liquor, peas of hard consistency, cotyledons prominent, and a starch content of over 45 per cent. in the dry matter, we find sixteen samples which have all these characters. They are Nos. 23811, 23774, 23945, 23821, 23955, 23944, 23832, 23784, 23761, 23957, 23789, 23735, 23753, 23739, 23928, 23942. While we cannot say definitely that these samples are soaked peas, we can say that they are of inferior quality. These samples likewise show a low water content, ranging from 72.83 to 78.51, with an average of 75.74 per cent., as compared with the general average of 80.86 and the maximum of 90.46 per cent.

The Nutriment of Canned Peas.

The following tabulation shows the average weights, in grams, of the different ingredients contained in a can of dried peas of the class indicated by the label.

The larger peas contain the larger amount of nutriment and cost less. Thus a can of "marrow" peas supplies 385 Calories, and a can of "petits pois" only 157. Furthermore, the former show an average cost of 11 cents per can, the latter 19 cents per can, making the cost per 100 Calories in "marrow" peas 2.9 cents, while in "petits pois" it is 12.1 cents, or over four times as much. There can be no argument as to which is the more economical purchase, but as already stated, delicacy and flavor are also important, and these are found in higher degree in the smaller, higher-priced peas.

NUTRIENTS PER CAN OF DRAINED PEAS, IN GRAMS.

	Ether Extract.	Crude Fiber.	Ash.	Protein.	Carbohydrates.	Sodium Chloride.	Pea Ash.	Reducing Sugars.	Starch.	Undetermined Carbohydrates.	Calories per 100 grams.
Petits Pois	0.90	4.70	3.14	10.29	25.97	1.91	1.23	6.22	16.44	3.31	[illegible]
Petits Pois Extra Fins	0.91	5.26	2.97	12.86	24.00	1.63	1.34	5.69	14.49	3.82	[illegible]
Petits Pois Fins	0.61	5.46	3.02	10.91	28.00	1.76	1.26	3.78	20.37	3.85	[illegible]
Extra Fins or Extra Sifted	1.13	4.88	2.78	11.21	25.00	1.62	1.16	7.77	13.09	4.14	[illegible]
Early June Extra Sifted	1.43	5.39	3.78	15.35	33.05	2.14	1.64	7.36	20.47	5.22	[illegible]
Sifted or Fins	1.62	6.55	3.87	16.47	41.49	1.76	2.11	10.61	26.19	4.69	[illegible]
Early June Sifted	1.55	7.25	4.35	19.50	53.35	2.43	1.92	7.10	41.88	4.37	[illegible]
Early June	1.76	7.17	4.53	19.79	50.75	2.49	2.04	6.15	38.93	5.67	[illegible]
Marrow Sifted	2.18	8.06	4.58	20.34	48.84	2.37	2.21	4.96	35.98	7.90	[illegible]
Marrow	1.45	8.03	4.94	24.00	66.58	2.26	2.68	7.83	55.14	3.61	[illegible]
Telephone	2.15	6.96	4.54	18.04	42.31	2.64	1.90	12.05	25.04	5.22	[illegible]

Metallic Contaminations.

To give the peas what the consumer has come to regard as a more attractive appearance, salts of copper or zinc are frequently used, especially in peas imported from Europe. The quantity of these metals present is usually small, and its effect on the health of the consumer has been a subject of long and still unsettled controversy. It is generally conceded that the occasional ingestion of a small amount of a copper or zinc salt may result in no noticeable injury to health. But the continued and regular ingestion of even small quantities of these metallic salts must be considered as at least prejudicial to health. While the Federal Government has taken a wavering attitude on this subject, first prohibiting the importation of "greened" peas, then later removing this embargo, provided the peas did not "contain an excessive amount of copper," the present requirement is that where "greening" is practiced, the fact must be clearly stated on the label. In this way the choice is left to the consumer, whether or not he shall use the artificially colored product.

Another source of metallic contamination is the tin used in making the container. In this country there is no restriction as to the quality of the tin employed, and in consequence the tin of some cans has been found to contain as much as 12 per cent. of lead.* Lead as a constituent of food products has as yet found

* McElroy and Bigelow, *loc. cit.*

no champion. The continued ingestion of even small amounts of it is followed by most serious results. Tin salts themselves are much less poisonous than lead, and are quite commonly found in canned vegetables. The solder used is another source of contamination, especially when it is allowed to come into contact with the contents of the can. Occasionally, too, through carelessness, fragments of solder are found in the peas, but these offer little danger to the consumer, as they would as a rule be easily detected. In only three samples were solder fragments found in noticeable quantities, in Nos. 23743, 23775 and 23738. In the first two the amount was small, but in the last it amounted to 1.5 gms. These fragments were excluded from the samples taken for analysis.

Lead was not found with certainty in any sample, although in six its absence was questionable.

Copper was found in fourteen samples, in twelve of which its presence was stated on the label. The other two, Nos. 23793 and 23808, *Lemoine Petits Pois Fins*, and *Rodier's Petits Pois Fins*, must be considered adulterated, as they contained 27 and 14 mgms. of copper per kilo of drained peas, respectively. The copper content of the "greened" peas ranged from 8 to 67 mgms. per kilo. The amounts of copper found in 23825, 23749 and 23949, namely, 45, 58 and 67 mgms. per kilo, are very excessive. In no case was copper found in peas packed in this country.

TABLE V.—COPPER IN DRAINED PEAS.

Station No.	Sold as.	Copper Mgms. per kilo of peas.	Station No.	Sold as	Copper Mgms. per kilo of peas.
23936	*Petits Pois	8	23808	Petits Pois Fins	14
23949	* " "	67	23807	*Extra Fins	13
23816	* " "	15	23791	* " "	16
23825	* " "	45	23755	*Fins	25
23750	*Petits Pois Extra Fins	18	23812	* "	15
23749	*Petits Pois Fins	58	23931	* "	28
23793	" " "	27	23927	*Medium	9

* Labeled "colored with sulphate of copper."

Tin was found in weighable quantities in eighty-eight of the 111 samples. The quantity ranged from 2 to 395 mgms. per kilo of drained peas.

Table VI.—Tin in Drained Peas.

Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.	Station No.	Tin Mgms. per kilo of peas.
23936	115	23824	28	23744	109	23746	78
23815	13	23812	30	23735	30	23828	24
23947	11	23755	142	23822	33	23743	9
23949	38	23959	20	23737	71	23734	40
23816	31	23795	69	23810	31	23939	23
23825	65	23806	21	23753	13	23730	19
23809	45	23772	20	23739	104	23747	4
23814	4	23778	38	23946	21	23940	28
23750	168	23834	18	23765	50	23775	101
23749	121	23954	45	23805	5	23804	4
23793	184	23821	59	23928	53	23820	44
23808	215	23803	23	23766	44	23941	2
23807	21	23950	13	23833	11	23754	19
23752	30	23796	30	23830	23	23733	25
23956	55	23955	56	23776	35	23953	37
23932	22	23736	36	23738	111	23748	24
23756	54	23832	39	23764	20	23817	51
23931	395	23792	44	23929	33	23800	8
23751	10	23761	70	23831	25	23942	12
23760	112	23937	36	23740	100	23927	50
23943	19	23957	54	23801	9	23958	27
23802	2	23745	8	23823	39	23938	18

No attempt was made to determine how much of this tin existed in a soluble form; if it were all insoluble, the possibility of danger from its use would be much decreased. Thirteen of these samples also contained so much copper that the consumer would receive a more than liberal dosage of metals. In 23749, for instance, he would ingest in one kilo of drained peas 121 mgms. of tin and 58 mgms. of copper. As one can of this sample contained 268 gms. of drained peas, each can contained about one-fourth of the above amounts, or 30 mgms. of tin and 15 mgms. of copper. In 23931 each can of drained peas contained about 100 mgms. of tin and 7 mgms. of copper. The differences in tin content of the peas packed in this country and those packed abroad is very striking. The tin content of the fourteen foreign samples ranged from none (in one sample) to 395, with an average of 113 mgms. per kilo; in the ninety-seven domestic samples it ranged from none (in twenty-three samples) to 112, with an average of 28 mgms. per kilo. The following tabulation shows more clearly the variations in the two sets of samples.

Tin Content (mgms. per kilo of Drained Peas).

Mgms. of Tin.	Foreign Packed. No. of Samples.	Foreign Packed. Per Cent.	Domestic Packed. No. of Samples.	Domestic Packed. Per Cent.
None	1	7	23	24
1 to 20	0	0	26	27
21 to 50	5	36	31	32
51 to 100	1	7	11	11
Over 100	7	50	6	6
	14	100	97	100

The superiority of the domestic peas as regards metallic contamination is marked.

Summary.

One hundred and eleven samples were examined, fourteen of foreign and ninety-seven of domestic packing.

The drained peas ranged in weight from 211 to 455 gms., average, 364 gms.; the weight of the liquor ranged from 101 to 305 gms., average, 206 gms.; the liquor made up from 27 to 50 per cent., average, 36 per cent., of the total weight of the sample.

The drained peas showed normal weight in 34 per cent. of the ninety-two samples packed in No. 2 cans, excess weight in 5 per cent., and a tendency toward short weight in 61 per cent. Three samples showed a great deficiency in fill of peas.

The peas cost from 8 to 30 cents per can, average, 13.5 cents. The cost per pound of drained peas ranged from 9.8 to 46.4 cents, average, 16.8 cents.; the smallest peas, "petits pois," averaging 29.8 cents, the "marrowfats" and "telephones," 13.1 and 14.4 cents, respectively.

The liquor was perfectly clear in no case; in ten it was slightly cloudy, in sixty-three cloudy, in thirty-three thick and in five very thick and pasty.

Thirty samples, or 27 per cent., showed over 0.4 inch of empty can, indicating short fill. In thirteen samples there was too little liquor for the peas, in thirty-one it was excessive and in seven very excessive.

The weight of one hundred drained peas ranged from 16 to 83 gms., average, 40 gms.

Of the seventy-two samples indicating a standard size on the label, twenty-three were true to size, thirty-four were smaller and fifteen larger.

The solid matter of the pea liquor ranged from 3.73 to 10.68 per cent., average, 6.67 per cent. On the average it was composed of 23 per cent. protein, 37 per cent. sugar, 23 per cent. starch, 5 per cent. pea ash, and 12 per cent. sodium chloride.

In fifty-six samples the pea liquor indicated the presence of glucose, ranging from 0.27 to 1.30 per cent. In no case was glucose declared on the label.

The liquor contained on the average 16 per cent. of the total solids of the canned peas. Ten per cent. of the starch and 16 per cent. of the protein of the peas are lost in the discarded liquor.

In the drained peas the water ranged from 72.83 to 90.46, average, 80.86 per cent.; starch from 2.04 to 15.65, average, 7.64 per cent.; sodium chloride from 0.09 to 1.12, average, 0.58 per cent.

In the smaller, less mature peas the fiber, sugar and ash are generally higher, while the starch is higher in the more mature peas.

In forty-eight samples the use of sugar was either declared on the label, or indicated in the brand name; in twenty-nine of the other sixty-three samples the sugar ranged from 12.27 to 24.49 per cent. in the dry matter, indicating added sugar.

On the average there is quite a close relation between the amount of water and starch in the drained peas and the amount of starch in the liquor. The average water steadily decreases as the starch increases.

Thirty samples contained from 21 to 30 per cent. of starch thirty-eight from 31 to 40 per cent.; thirty from 41 to 50 per cent., and thirteen over 50 per cent., dry basis.

Thirty-five samples contained 45 per cent. or more of starch dry basis; sixteen of these by their high starch content, by their thick liquor, by the hardness of the peas and by the prominence of the cotyledons, and by their low water content, 72.83 to 78.51 per cent., are shown to be either "soaked peas" or over-mature peas of inferior quality.

The larger, more mature peas contain the most actual nutriment, a can of "marrowfats" supplying 385 Calories, a can of "petits pois" 157 Calories. The cost of 100 Calories in the "marrowfats" is 2.9 cents, in the "petits pois," 12.1 cents.

Lead was found with positive certainty in no sample.

Copper was found in fourteen samples, all of foreign pack, ranging from 8 to 67 mgms. per kilo of drained peas.

Tin was found in weighable quantities in eighty-eight samples, ranging from 2 to 395 mgms. per kilo of drained peas. Thirteen of these also contained copper. In the peas packed abroad the tin ranged from none (in one sample) to 395, average, 113 mgms. per kilo; in the domestic peas, from none (in twenty-three samples) to 112, average 28 mgms. per kilo.

METHODS OF ANALYSIS.

Physical.

Preliminary Examination. Weigh the full can unopened; open can carefully close to the edge, avoiding all loss, and pour off the liquor through a sieve, allowing the peas to drain for one minute; catch the liquor in a tared flask, and weigh; also weigh the empty can. From these weights the weights of the total contents of the can, of the solid contents, together with adhering moisture, and of the liquid contents are calculated.

On opening the can note whether there is an outflow of gas, any corrosion or discoloration of the can, and whether the contents of the can are covered with a mucilaginous film. Measure the distance between the surface of the liquor and the top of the can, and the depth of the liquor above the peas. Note also color and consistency of peas and whether they are smooth or wrinkled; note development, if any, of cotyledons.

After weighing the sample, count out one hundred peas, fairly representative of the whole sample, and weigh. Grade these peas by size by means of a series of sieves containing openings $\frac{9}{32}$, $\frac{10}{32}$, $\frac{11}{32}$, $\frac{12}{32}$ and $\frac{13}{32}$ of an inch in diameter. Record number of peas of each grade, and grade as Nos. 1, 2, 3, 4, 5 and 6 respectively. The separations must be done quickly to avoid excessive losses of moisture.

Prepare salt solutions of 1.04 and 1.07 sp. gr. Determine in a cylinder how many of the counted hundred peas float in the 1.04 solution, those which sink in the 1.04 and float in the 1.07 solution, and those which sink in the 1.07 solution. Grade these as quality 1, 2 and 3 respectively.

Dry the remainder of the solid contents of the can (total peas less one hundred) at not over 100° C. until sufficiently dry for grinding so as to pass a $\frac{1}{50}$ in. sieve. Pick out all globules of solder as far as possible before grinding, and also separate other particles which may appear during the sifting of the sample.

Bottle the ground sample and use for analysis.

Chemical.

Liquor. Determine water, ash and protein in 25 gm. portions in the usual way. Polarize before and after inversion.

Drained Peas. Determine water, ether extract, crude fiber, protein and ash in the usual way.

Determine *sodium chloride* by washing residue from ash determination into a 100 c.c. flask with water and enough dilute nitric acid to make Congo red blue. Add powdered calcium carbonate to distinct alkalinity and boil to expel carbonic acid. Cool, make up to the mark, filter and pipette 50 c.c. of the filtrate into a beaker, and titrate with tenth-normal silver nitrate solution, using potassium chromate as indicator.

Determine *crude starch* in 4 gms. of material by the diastase method.

Heavy Metals.

Char 25 grams of material in a porcelain dish. Moisten the charred mass with concentrated sulphuric acid and burn as completely as possible, adding nitric acid if necessary. Digest the ash on steam-bath for fifteen minutes with 15 c.c. of water and a few drops of 50 per cent. sulphuric acid. Filter and wash with hot water. The residue (I) may contain lead sulphate, insoluble tin and silica. The filtrate (II) will contain any copper, zinc and soluble tin.

Wash residue (I) into a beaker with 25 c.c. of 10 per cent. acid ammonium acetate, heat to boiling, filter and wash with hot water. This removes lead, which may be determined in the filtrate as lead sulphate by the alcohol method. The residue (III) contains insoluble tin and silica.

Acidify filtrate (II) with 2-3 c.c. of concentrated hydrochloric acid and pass hydrogen sulphide into the hot solution so long as a precipitate forms. Place upon a steam bath and allow the sulphides to settle. Filter and wash with hot water containing hydrogen sulphide. This removes zinc, which may be determined in the filtrate. The insol. residue (IV) contains the sulphides of copper and tin.

Unite residues (III) and (IV) and fuse for 20 minutes in a covered porcelain crucible with three times their weight of a mixture of equal parts of sodium carbonate and sulphur. Dissolve the fused mass in water, transfer to a beaker and boil for five minutes. Filter and wash with hot water. Acidify the filtrate with a few drops of concentrated hydrochloric acid and place upon a steam bath to facilitate the separation of tin sulphide. Filter, wash with water, ignite in a porcelain crucible with access of air and weigh as SnO_2.

Boil the residue, left after filtering the fused mass with dilute nitric acid for five minutes. Filter and wash with hot water. Neutralize the filtrate with ammonia and add a few drops of concentrated hydrochloric acid. Precipitate the copper by passing hydrogen sulphide into the solution, filter off the copper sulphide and wash with hot water. Ignite in hydrogen and weigh as the sulphide Cu_2S. For the small amount of copper obtained it is practicable to ignite in air and weigh as CuO.

CANNED SOUPS.

The meat of soup stock yields to water a large part of its so-called "extractives" and mineral matter. The small quantities of protein or flesh-forming material which are dissolved

in water are made insoluble again by cooking and are skimmed off with the fat. From the connective tissue of meat some gelatin is formed by cooking, which remains in the finished clear soup, and is what causes it to "set" to a jelly if quite concentrated, but this gelatin has not a high nutritive value.

It follows that a clear soup, like bouillon, contains but little nutriment. Nevertheless the salts and extractives in a soup, which are the flavoring constituents of the meat, have a dietetic value as "appetizers" and aids to digestion through the stimulation of the flow of gastric juice.

Soups thickened with cereals or to which prepared vegetables or meats are added contain of course much more nourishment than clear meat soups.

The serving of soup at the beginning of a meal is an entirely rational practice.

These two types of soup, namely clear meat soup and vegetable soup, are represented in the eighteen samples examined; six of bouillon and twelve of tomato soup. The analyses are given in Tables VII and VIII.

Bouillon.

The samples contained from 92.03 to 96.41 per cent. of water, or from 3.59 to 7.97 per cent. of solid matter. The ether extract

TABLE VII.—CANNED SOUP—BOUILLON.*

Station Number.	Brand.	Net weight of soup.	Price per can.	Cost per lb. of soup.	Water.	Ash.	Ether Extract.	Protein (N x 6.25).	Undetermined.	Chlorine calculated as salt.	Nitrogen.
		oz.	cts.	cts.							
23935	Amcehat. Acker, Merrall & Condit Co., N. Y.	11.2	9	12.9	92.03	1.65	0.08	2.03	4.21	1.41	.324
23952	Schimmel's. The American Preserve Co., Phila.	10.8	8	11.9	94.74	2.48	0.09	0.83	1.86	2.26	.133
23762	Campbell's. Joseph Campbell Co., Camden, N. J.	10.7	9	13.5	93.75	2.01	0.06	1.32	2.86	1.81	.211
23951	Blue Label. Curtice Bros. & Co., Rochester, N. Y.	33.7	30	14.2	95.67	1.23	0.15	2.09	0.86	0.93	.334
23763	The Franco-American Food Co.	32.6	28	13.7	95.05	1.10	0.06	1.56	2.23	0.89	.250
23757	Mohican. The Mohican Co., New York	11.2	9	12.9	96.41	2.68	0.09	0.49	0.33	2.48	.079
	Average				*94.61*	*1.86*	*0.09*	*1.39*	*2.05*	*1.63*	*.222*

*Contain no benzoic or salicylic acid.

was low in all samples, while the ash and protein showed considerable range. The range of percentage of ash was caused by the common salt, which made up from 18 to 69 per cent. of the total solid matter of the soup, and was excessive in Nos. 23952 and 23757. In these two samples the protein matter is also extremely low; namely, 0.83 and 0.49 per cent., respectively.

The analyses show that at most the amount of nutriment in bouillon is small, while in some samples there is almost no nutriment. In one case the purchaser pays nearly 13 cents per pound for a material, nearly 99 per cent. of which is water and salt.

None of the samples contained benzoic or salicylic acid.

The samples cost from 11.9 to 14.2 cents per pound of soup, with an average of 13.2 cents.

TABLE VIII.—CANNED SOUP—TOMATO.*

Station Number.	Brand.	Net weight of soup.	Price per can.	Cost per lb. of soup.	Water.	Ash.	Ether Extract.	Protein (N x 6.25).	Nitrogen-free Extract.	Chlorine calculated as salt.	Nitrogen.
		oz.	cts.	cts.							
23934	Amcehat. Acker, Merrall & Condit Co., N. Y.	11.7	9	12.3	84.01	3.68	0.69	1.41	10.21	2.96	.225
23741	Camphell's. Joseph Campbell Co., Camden, N. J.	11.7	10	13.7	85.06	2.48	0.80	1.18	10.48	1.96	.189
23781	Columbia Clear. Columbia Conserve Co., Ind'napolis	15.3	15	15.7	89.18	1.62	0.25	0.97	7.98	1.15	.155
23933	Blue Label. Curtice Bros. Co., Rochester, N. Y.	34.0	30	14.1	91.23	1.31	0.24	1.06	6.16	0.99	.170
23827	The Franco-American Food Co.	16.9	18	17.0	88.61	1.59	0.16	1.88	7.76	1.28	.300
23818	A. & P. The Great Atlantic & Pacific Tea Co., N. Y.	11.6	9	12.4	80.54	3.49	0.57	1.50	13.90	2.83	.240
23742	Heinz. H. J. Heinz Co., Pittsburg, Pa.	30.5	25	13.1	88.21	2.26	2.08	1.07	6.38	1.66	.171
23769	Mohican. The Mohican Co., New York	11.7	10	13.7	83.17	3.42	0.55	1.60	11.26	2.73	.256
23948	P. & W. Potter & Wrightington, Boston	11.6	8	11.0	83.29	2.77	0.70	1.44	11.80	2.02	.230
23794	Richardson & Robbins, Dover, Del.	32.1	25	12.5	89.74	1.25	1.13	2.38	5.50	0.66	.380
23829	Snider's. The T. A. Snider Preserve Co., Cin., O.	11.5	10	13.9	84.90	1.75	0.22	1.81	11.32	1.00	.290
23770	Van Camp's. The Van Camp Packing Co., Indianapolis	11.4	9	12.6	83.82	2.57	0.98	1.61	11.02	1.90	.258
	Average				*85.98*	*2.35*	*0.70*	*1.49*	*9.48*	*1.76*	*.239*

*Contain no benzoic or salicylic acid.

Tomato Soup.

The samples contained from 80.54 to 91.23 per cent. of water, or from 8.77 to 19.46 per cent. of solid matter. The range of percentages of all the ingredients was much greater than in the case of bouillon. The amount of salt added was much less than in the bouillons, 19 per cent. of the solids being the maximum. The wide differences in percentages of nitrogen-free extract are due in some cases, as in No. 23818, to the addition of starch and sugar. The differences in percentage of ether extract, from 0.16 to 2.08 per cent., are very striking. The highest fat is found in No. 23742, in which the label states that the manufacturer has used "pure sweet cream," a statement which is supported by the analysis.

These analyses show that tomato soup contains very much more actual nutriment than bouillon. The solids are about two and one-half times greater, and in addition to considerable quantities of fat, starch and sugar are present in considerable amounts.

None of the samples contained benzoic or salicylic acid or artificial color.

The cost per pound of soup ranged from 11 to 17 cents, the average cost, 13.5 cents, being only slightly higher than that of bouillon.

FLAVORING EXTRACTS.

Our examination this year includes fourteen samples of almond, two of banana, thirty-four of ginger, twenty of orange, thirteen of peppermint, thirteen of pineapple, seven of raspberry, fifteen of strawberry, and eleven of wintergreen extracts. In addition we have examined for the dairy commissioner two ginger, five lemon, two orange, five peppermint, three vanilla, and one wintergreen extract.

The law unfortunately permits, in the case of a drug of less than standard U. S. P. strength, a statement of its strength on the label. This provision does not apply to foods, under which head flavoring extracts are included. If, for instance, a lemon extract contains only 3 per cent. of lemon oil instead of the standard 5 per cent., it cannot legally be labeled "lemon extract, three-fifths standard strength," for the product is not entitled to the name

"lemon extract" at all. It might be labeled "compound lemon extract and water," or "imitation lemon extract," as the case might be, but in all cases its compound nature should be stated clearly on the label. Many manufacturers still seem to be unable or unwilling to understand this point in the law.

Almond Extract.

Standard almond extract is "the flavoring extract prepared from oil of bitter almonds, free from hydrocyanic acid, and contains not less than one (1) per cent. by volume of oil of bitter almonds."

The unpurified oil of bitter almonds consists chiefly of benzaldehyde, with a small amount of hydrocyanic acid, which is extremely poisonous. Benzaldehyde is produced artificially, and this synthetic benzaldehyde has the same properties as pure oil of bitter almonds, and possesses the great advantage of freedom from hydrocyanic acid. For this reason it has largely taken the place of the natural oil in the market.

The chief adulterants of almond extract are hydrocyanic acid and nitrobenzol. Occasionally also there is a deficiency of almond oil and alcohol.

Of the fourteen samples examined, eight contained the standard amount of almond oil, and were free of hydrocyanic acid and nitrobenzol. Six samples were adulterated; five were below standard in almond oil, two contained hydrocyanic acid, and one nitrobenzol. Sample 23680, although containing only 0.84 per cent. of the oil, was misbranded "triple strength." Sample 23246 bore the indefinite and misleading formula "70 parts hydro-alcoholic sol. oil almond, 30 parts aqua." As the strength of the "hydro-alcoholic solution" is not specified, the label conveys no useful information.

The cost of the pure extracts ranged from 15 to 25 cents for from 1.8 to 3.2 fluidounces, with an average cost of 9.3 cents per fluidounce. In the adulterated extracts the cost ranged from 10 to 30 cents for from 1.1 to 2.2 fluidounces, with an average cost of 10 cents per fluidounce.

Four samples were guaranteed on the label as to quantity. These guarantees were met in all cases except in sample 23082, where there was a deficiency of 10 per cent.

For methods of analysis see page 515.

Station Nur	Brand.	Dealer.	Price per bottle cts.	Capacity of bottle, fluid	Volumetric.	Gravimetric.	Remarks.
23679	Burnett's Superior Extract of Almond. Joseph Burnett Co., Boston	*New Haven:* E. E. Hall	18	2.1	1.43	---	
23251	Capital House Pure Extract Almond	*Middletown:* Middletown Cash Groc.	20	2.0	---	1.32	
23017	A. & P. Almond. The Great Atlantic & Pacific Tea Co., New York	*Bridgeport:* Atlantic & Pacific Tea Co.	25	1.9	---	1.39	
23083	Howco Pure Flavoring Extracts, Almond	*Bridgeport:* Howland Dry Goods Co.	15	1.8	1.85	1.86	
23020	Monogram Brand Finest Extract Almond	*Bridgeport:* Bridgeport Public Market	20	2.1	1.42	1.46	
23082	Van Duzer's Fruit Extracts High. Conc. Almond. Van Duzer Extract Co., N. Y.	*Milford:* Perry & Perry	20	1.8	1.01	1.03	
23677	Van Dyk's Ambassador Brand Extract of Almond. James Van Dyk Co., N. Y.	*Bridgeport:* Van Dyk's Tea Store	19	3.2	1.10	---	
23072	Williams Pure Extract of Almond. The Williams & Carleton Co., Hartford	*West Haven:* R. G. Green	20	2.0	2.01	2.01	

TABLE X.—ALMOND EXTRACT BELOW STANDARD, OR ADULTERATED.

23673	Monarch Flavoring Extr's Almond, High. Conc. Austin, Nichols & Co., N. Y.	*Bridgeport:* Bridgeport Public Market	18	2.2	1.06	---	Contains hydrocyanic acid.
23680	*Colton's Select Flavors Almond. J. W. Colton, Springfield, Mass.	*New Haven:* John R. Gilbert & Son	30	2.0	0.84	---	Label illegal.
23309	Harris' Pure Extract Almond. Frank E. Harris, Binghamton, N. Y.	*Hartford:* Brown, Thomson & Co.	15	1.1	0.93	0.93	
23037	Pansy Almond Flavoring Compound. Pansy Extract Co., (The A. Colburn Co., Phila.)	*Stamford:* New York Cash Grocery	10	1.4	---	---	Contains nitrobenzol.
23246	†St. John's Extract of Almond. St. John & Co., New York	*Middletown:* C. A. Allison	15	1.8	0.71	0.72	Label misleading.
23085	Van Dyk's Ambassador Brand Extract of Almond. James Van Dyk Co., N. Y.	*Bridgeport:* Van Dyk's Tea Store	10	1.3	0.82	0.85	Contains hydrocyanic acid.

* Labeled on bottle "Triple Strength."

† Formula given as "70 parts hydro-alcoholic sol. oil almond, 30 parts aqua," which is indefinite and misleading.

Banana Extract.

Both of the samples examined were synthetic, or artificial, flavors. Sample 23025 was correctly labeled "imitation," while sample 23229 was illegally labeled, one side of the carton reading "best banana" and the other side "best artificial banana flavoring." The average cost was 9.1 cents per fluidounce.

Ginger Extract.

Standard ginger extract is "flavoring extract prepared from ginger, and contains, in each one hundred (100) cubic centimeters, the alcohol-soluble matters from not less than twenty (20) grams of ginger."

The above standard is the same as required by the U. S. P. for medicinal Tincture of Ginger.

To compare the strength of a ginger extract with the standard, it is necessary to know how much alcohol-soluble matter powdered ginger root will yield. From an examination of the literature it is apparent that the kind of ginger used has an important bearing on the strength of the extract. The most complete examinations of authentic samples of ginger have been made by Winton, Ogden and Mitchell* and by Reich.† The average alcohol-soluble matter determined by them, using the same method, is shown below:

	Winton.	Reich.
Jamaica	4.97	....
Cochin	5.00	3.96
Japan	5.02	5.80
African	6.34	6.64
Calcutta	4.33	4.36
All samples	5.18	5.19

The individual samples showed considerable variation with both analysts, Winton's ranging from 3.63 to 6.58 per cent. and Reich's from 3.24 to 8.05 per cent., the maximum in both cases being secured from African ginger. These solubilities were obtained by using alcohol 95 per cent. by volume. While these variations are considerable, we are chiefly concerned with Jamaica and African ginger, the more commonly used varieties, and in these the variations are somewhat smaller, from 4.04 to 8.05.

* Conn. Agl. Expt. Station, Report, 1898, 203.

† Zeit. Unter. Nahr. u. Genuss., 1907, *14*, 549.

From these figures we would expect 100 cc. of standard extract of ginger to contain from 0.80 to 1.60 gm. alcohol-soluble solids, or based on a specific gravity of 0.820, 0.97 to 1.94 per cent.

Two samples of tincture of ginger were prepared in this laboratory, following the U. S. P. directions, which should give a preparation of the same strength as the standard extract. The analyses are given below:

U. S. P. TINCTURE OF GINGER.

	Jamaica.	African.
Specific gravity, 15.6° C.	.8198	.8222
Alcohol by volume	94.63	93.21
Total solids	1.43	1.81
Solids soluble in 95 per cent. alcohol	1.42	1.81
" " " cold water	0.21	0.16

The most striking characteristic of these tinctures is the high alcohol-solubility of the solids; it is also striking that only a small proportion of the material soluble in 95 per cent. alcohol is likewise soluble in cold water. From these analyses and those of Winton and Reich it would seem that a properly prepared extract of ginger should show a specific gravity of about .820, and should contain at least 93 per cent. alcohol by volume, from one to two per cent. of solids, practically all of which should be soluble in 95 per cent. alcohol, and not over 15 per cent. of it soluble in cold water. Numerous authorities assert that a minimum of 1 per cent. of solids should be found in a pure ginger extract.

The most common form of adulteration of this extract is the use of alcohol of low strength. As ginger root contains much more (in Jamaica ginger three times as much) matter soluble in water than in alcohol, weak alcohol will dissolve more material from ginger root, than strong alcohol. This increased extractive, however, adds nothing to the value of the extract, while the valuable principles of the root, the essential oil and the oleoresins, are not completely dissolved by the weak spirits. A determination of solids alone then shows little as to the quality of the extract, not only because a weak alcohol may have been used, but also because sugar or glycerol or both are frequently used to fortify weak extracts.

The lead member, similar to that suggested by Winton for maple syrup and later for vanilla extract, was determined in a

TABLE XI.—EXTRACT OF GINGER

Station Number.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fl. oz.
24936	Colburn's Ess. Jamaica Ginger. The A. Colburn Co., Phila.	*Bridgeport:* L. Kopp	10	1.0
25033	Pure Flav. Extr. of Ginger. East India Tea Co.	*So. Norwalk:* East India Tea Co.	20	1.7
25065	Littell's Conc. Ess. of Jamaica Ginger. C. S. Littell & Co., N. Y.	*Wilton:* R. W. Keeler	20	2.8
24962	Jamaica Ginger. McMonagle & Rogers, Middletown, N. Y.	*New Haven:* Carlson Tea and Butter Co.	25	1.9
24983	Conc. Extract Ginger. Nichols & Harris, New London	*New London:* F. H. Davis & Co.	20	2.0
25032	Sovereign Essence Jamaica Ginger. Union Pac. Tea Co.	*So. Norwalk:* Union Pacific Tea Co.	25	2.9
24960	Williams' Extr. of Jamaica Ginger. Williams & Carleton Co., Hartford	*New Haven:* D. M. Welch & Son	20	2.1
	Made in laboratory from Jamaica ginger		....	....
	Made in laboratory from African ginger		....	....

TABLE XII.—EXTRACT OF GINGER

24939	Hudson Brand Imitation Extr. Jamaica Ginger. Austin, Nichols & Co., N.Y.	*Bridgeport:* Village Store Co.	10	2.9
25077	A. & P. Jamaica Ginger. Great Atl. and Pac. Tea Co.	*New Haven:* Atl. & Pac. Tea Co.	25	2.0
24935	Sol. Extr. Jam. Ginger, Stuart Brand. The Hartford Extract Co., Hartford.	*Bridgeport:* Public Market Co.	10	1.7
24963	Loveday's Ginger Compound. Loveday's Premium House, New Haven	*New Haven:* Loveday's Tea Store	20	2.7
25031	Ginger Extract Colton. St. John & Co., New York	*Norwalk:* G. T. Bruce.	10	2.2
23079	Ginger Extract Colton. St. John & Co., New York	*Bridgeport:* H. Isenberg & Co.	15	2.6
23164	Compound Jam. Ginger. Yale Tea Co., Waterbury	*Waterbury:* Yale Tea Co.	10	1.8

number of the samples. In the samples made in the laboratory, lead numbers of 0.23 and 0.29 were obtained, while in the samples classed as pure 0.24, 0.28 and 0.36 were secured. On the other hand the compound and adulterated extracts showed simi-

UP TO STANDARD.

Station Number.	Specific gravity at 15.6°C.	Alcohol by volume.	Solid Matter. Total.	Solid Matter. Soluble in alcohol.	Solid Matter. Soluble in water.	Per cent. of total solids soluble In alcohol.	Per cent. of total solids soluble In water.	Lead number.	Remarks.
24936	.8347	92.41	0.94	0.94	0.36	100	38	....	Labeled 90% alcohol.
25033	.8249	96.18	1.45	1.41	0.34	97	23	....	Labeled 95% alcohol, one-half standard strength.
25065	.8218	94.38	1.04	1.03	0.26	99	25	....	Labeled 93% alcohol.
24962	.8269	96.25	1.47	1.46	0.22	99	15	0.36	
24983	.8246	90.59	1.37	1.31	0.08	96	6	....	Labeled "clear alcohol."
25032	.8339	93.30	1.52	1.45	0.29	95	19	0.24	
24900	.8366	93.37	1.85	1.72	0.39	93	21	0.28	Labeled 94% alcohol.
....	.8198	94.63	1.43	1.42	0.21	99	15	0.23	
...	.8222	93.21	1.81	1.81	0.16	100	9	0.29	

LEGALLY LABELED COMPOUNDS.

Station Number.	Specific gravity at 15.6°C.	Alcohol by volume.	Solid Matter. Total.	Solid Matter. Soluble in alcohol.	Solid Matter. Soluble in water.	Per cent. of total solids soluble In alcohol.	Per cent. of total solids soluble In water.	Lead number.	Remarks.
24939	.9584	48.55	6.45	1.20	6.08	19	94	0.19	Formula: 42% alcohol, Jamaica ginger, caramel, alcohol, sugar, water.
25077	.9242	56.07	0.87	0.87	0.22	100	25	....	Labeled 60% alcohol.......
24935	.9948	38.07	10.14	0.86	9.72	8	96	0.73	Labeled 40% alcohol. Contains ginger root, alcohol, molasses, water.
24963	.9588	37.28	0.49	0.42	0.41	86	84	....	Contains ginger, capsicum, alcohol and water.
25031	.9765	36.70	4.89	0.43	4.26	9	87	0.24	Labeled ½ standard strength. Contains 32% alcohol, glycerine, sugar & water.
23079	.9921	35.20	5.41	2.86	4.92	53	91	....	Labeled same as 25031.
23164	.9557	39.35	1.18	0.54	1.01	46	86	....	Formula claims extr. Jam. ginger, oleo resin ginger, oleo resin capsicum, essence oil ginger, 20% alcohol and caramel.

larly low numbers in the great majority of cases, although in two samples 0.70 and 0.73 were secured. In one of these molasses was declared on the label. It does not appear that this determination has much value in determining the purity of a

TABLE XIII.—EXTRACT OF GINGER

Station Number.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fl. oz.
25024	Monarch Conc. Ess. Jam. Ginger. Austin, Nichols & Co., N. Y.	*Stamford:* Brown & Webb	24	3.9
23043	Sunbeam Extr. Jam. Ginger. Austin, Nichols & Co., N. Y.	*Stamford:* W. W. Waterbury	15	1.9
23069	Pure Extract of Ginger. Clark Extract Co., West Haven	*West Haven:* C. S. Atzback	10	1.0
25066	Colton's Conc. Ess. or Extr. Jamaica Ginger. J. W. Colton	*Danbury:* Robertson & Menzies	25	2.2
24937	Essence Jamaica Ginger, Colton's	*Bridgeport:* Charles D. Richards	10	2.5
25011	Benefit Brand Pure Jam. Ginger. Direct Imp. Co., Boston	*Willimantic:* Direct Importing Co.	13	1.9
24938	Pure Jamaica Ginger. Donzales & Co., Kingston, Jam.	*Bridgeport:* P. D. Lyon	20	2.6
23107	Goodhonest Brand Essence Ginger	*Wilton:* R. W. Keeler	20	3.1
23078	Extract Jamaica Ginger. Grand Union Tea Co.	*Bridgeport:* Grand Union Tea Co.	20	2.0
23123	A. & P. Jamaica Ginger Extr. Great Atl. & Pac. Tea Co.	*Danbury:* Atlantic & Pacific Tea Co.	20	1.8
23019	Imperial Pure Extr. of Jamaica Ginger. Springfield, Mass.	*Bridgeport:* D. E. McNamara	10	1.1
23253	Dr. McKee's Conc. Extr. Jam. Ginger. McKee Medicine Co., Middletown.	*Middletown:* The Village Grocery	20	2.0
24959	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	21	2.0
23664	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	2.0
23080	Mohican Pure Extr. of Ginger. The Mohican Co., N. Y.	*Bridgeport:* The Mohican Co.	21	1.9
25010	Supreme Conc. Extract Ginger. The T. R. Sadd Co.	*Willimantic:* The T. R. Sadd Co.	20	1.4
24982	*Extract Jamaica Ginger. Seeman Bros. New York	*New London:* James Kiehy	10	2.9
24961	Pure Extract of Jam. Ginger. Shartenberg & Robinson	*New Haven:* Shartenberg & Robinson	19	2.5
24997	Aromatic Extract Jam. Ginger. J. E. Thompson	*Norwich:* Disco Bros.	25	3.2
23666	Ambassador Brand Extr. or Ess. Jam. Ginger. James Van Dyk Co., N. Y.	*New Haven:* Van Dyk Co.	10	1.2

* Labeled "Contains the alcoholic soluble matter from 6.5 gms. Jamaica Ginger and 41% ethylic alcohol."

ginger extract, although a high number is a reasonably certain indication of the presence of molasses.

Of the thirty-four samples examined, seven show standard composition, seven are legally labeled compounds, and twenty are

BELOW STANDARD OR ADULTERATED.

Station Number.	Specific gravity at 15.6° C.	Alcohol by volume.	Solid Matter. Total.	Solid Matter. Soluble in alcohol.	Solid Matter. Soluble in water.	Per cent. of total solids soluble. In alcohol.	Per cent. of total solids soluble. In water.	Lead number.	Remarks.
25024	.9184	59.88	2.17	1.12	1.51	52	70	0.25	Low alcohol; high water-soluble solids.
23043	.9128	62.50	1.30	0.94	0.70	72	54	0.23	Labeled 57% alcohol; high water-soluble solids.
23069	.8903	69.00	0.80	0.80	....	100	..	....	Low alcohol.
25066	.8904	75.87	2.42	1.54	1.27	64	52	....	Low alcohol; high water-*soluble solids.*
24937	.9900	21.35	4.29	0.63	3.57	15	83	0.50	Low alcohol; high water-soluble solids.
25011	.9325	46.96	0.36	0.36	0.14	100	39	....	Low alcohol; low solids.
24938	.9567	54.28	9.90	1.39	9.12	14	92	....	Low alcohol; high water-soluble solids.
23107	.9734	24.15	0.59	0.43	0.52	73	88	0.18	Low alcohol & solids; high water-soluble solids.
23078	9031	67.60	2.05	1.21	1.29	59	63	0.42	Low alcohol; high water-soluble solids.
23123	.9232	49.90	0.70	0.68	0.16	97	23	....	Low alcohol and solids.
23019	.8602	80.75	1.62	1.38	0.81	85	50	0.26	Low alcohol; high water-soluble solids.
23253	.8284	95.00	0.52	0.52	0.07	100	13	....	Low solids; not "concentrated."
24959	.9617	34.90	0.59	0.56	0.58	95	98	....	Low alcohol & solids; high water-soluhle solids.
23664	.9608	33.35	0.58	0.58	0.40	100	69	0.24	Low alcohol & solids; high water-soluble solids.
23080	.9718	25.90	0.63	0.42	0.56	67	89	....	Low alcohol & solids; high water-soluble solids.
25010	.9133	62.15	0.96	0.41	0.82	43	85	....	Low alcohol; high water-soluble solids.
24982	.9657	35.93	2.17	0.21	1.97	10	91	0.70	Low alcohol; high water-soluble solids.
24961	.8997	69.32	2.85	1.55	1.80	54	63	0.39	Low alcohol; high water-soluble solids.
24997	.9260	50.61	1.91	1.20	1.53	63	80	0.32	Low alcohol; high water-soluble solids.
23666	.9175	66.70	6.46	4.50	4.48	70	70	0.50	Low alcohol; high water-soluble solids.

below standard or adulterated. The analyses are given in Tables XI to XIII.

The standard samples ranged in specific gravity from .8218 to .8366, average, .8291; alcohol from 90.59 to 96.18, average, 93.78; total solids from 0.94 to 1.85, average, 1.38; solids soluble in

alcohol from 0.94 to 1.72, and solids soluble in water from 0.08 to 0.39. From 93 to 100 per cent. of the solids was soluble in alcohol, and from 6 to 38 per cent. in water.

The compound extracts were made with dilute alcohol and contained sugar, molasses, glycerol, caramel or capsicum, alone or in mixture. Their specific gravities ranged from .9242 to .9948, alcohol from 35.20 to 56.07, total solids from 0.49 to 10.14, solids soluble in alcohol from 0.42 to 2.86, and solids soluble in water from 0.22 to 9.72. From 8 to 100 per cent. of the solids was soluble in alcohol, and from 25 to 96 per cent. in water.

The extracts below standard or adulterated were so classed either because of low alcohol percentages or because of an excess of water-soluble solids. In some cases these solids were derived only from the ginger root itself, while in others they were due, at least in part, to added glycerol, sugar or molasses. Some of the weakest extracts were illegally labeled "concentrated." The samples ranged in specific gravity from .8284 to .9900, alcohol from 21.35 to 95.00, total solids from 0.52 to 9.90, solids soluble in alcohol from 0.21 to 4.50, and solids soluble in water from 0.07 to 9.12. From 10 to 100 per cent. of the solids were soluble in alcohol, and from 13 to 92 per cent. in water.

For methods of analysis see page 515.

Eight of the samples were sold in flat flasks, which seemed more suitable for hip-pocket use than for use in the kitchen. As most of these samples were relatively low in ginger extractive and alcohol, their use as a beverage is by no means impossible or improbable.

The Extractives of Ginger Root.

Attention has already been called to the amount of extractives obtained by Winton, Reich and this laboratory in samples of ginger root of known purity, using 95 per cent. alcohol as the solvent. It occurred to us that perhaps the high solids found in some samples, and the abnormally high proportion of these soluble in water, might in certain cases have been due quite as much, if not entirely, to the weak alcohol employed as to added sugar or glycerol. To test this point a series of extracts was made in the laboratory with alcohols of different strength, and the solids determined in them with the following results:

	95 Per Cent. Alcohol.	60 Per Cent. Alcohol.	20 Per Cent. Alcohol.
Total solids	1.43	1.91	2.59
Solids soluble in alcohol	1.42	1.16	0.30
" " " cold water	0.21	1.23	2.09

These results are what would be expected. As the alcoholic strength decreases the amount of solids increases, and a greater proportion is soluble in water and less in alcohol.

Orange Extract.

Standard orange extract is "the flavoring extract prepared from oil of orange, or from orange peel, or both, and contains not less than five (5) per cent. by volume of oil of orange."

The usual adulterations of orange extract are a deficiency in oil or use of artificial color. The so-called "terpeneless" orange extracts are sometimes sold as the genuine extract; in these all or nearly all of the terpenes, which make up about 90 per cent. of orange oil, have been removed.

Twenty samples were examined. Thirteen of these were of standard strength or above it and of natural color. These contained from 5.11 to 9.32 per cent. of oil, with an average of 6.65. The precipitation method in all cases gave somewhat higher results, averaging 0.22 per cent.

Seven samples were adulterated or illegally labeled. Four were deficient in oil, two were colored with turmeric, and four with coal-tar dyes. Sample 23692, although labeled "concentrated," contained no orange oil whatever and was artificially colored. Sample 23252, although containing a high percentage of oil, was artificially colored. Sample 23182 contained only a trace of oil, was artificially colored, and showed only about 46 per cent. of alcohol, indicating adulteration with water. Sample 23041, labeled "concentrated," likewise contained only a trace of oil, was artificially colored, and contained only about 54 per cent. of alcohol, also indicating adulteration with water.

The average cost of the pure extracts was 10.3 cents per fluidounce. That of the adulterated extracts was 8 cents per fluidounce.

Five samples were guaranteed as to quantity, three of which satisfied the guaranty. Samples 23162 and 23081 each showed a deficiency of 5 per cent.

For methods of analysis see page 516.

TABLE XIV.—ORANGE EXTRACT UP TO STANDARD.

Station No.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Orange Oil by Volume. Polariscope Method. %	Orange Oil by Volume. Precipitation Method. %	Refraction of Oil at 30° C.	Color.
23042	Republic Extract Orange. Austin, Nichols & Co., *New York	*Stamford:* W. W. Waterbury	15	2.2	5.11	5.20	1.4672	Natural
23162	Extract Orange. Grand Union Tea Co., Brooklyn, N. Y.	*Waterbury:* Grand Union Tea Co.	25	1.9	5.82	6.10	1.4678	"
23308	Pure Extract Orange. Frank E. Harris, Binghamton, N. Y.	*Hartford:* Brown, Thomson & Co.	15	1.0	7.47	7.60	1.4665	"
23245	Extract Orange. J. G. Hedges, Middletown	*Middletown:* Thos. Walsh	25	1.8	6.20	6.40	1.4675	"
23283	Imperial Pure Flavoring Extracts, Orange. Prep. at Springfield, Mass.	*Meriden:* Eastern Tea Importing Co.	8	1.0	9.32	9.90	1.4668	"
23661	Imperial Pure Flavoring Extracts, Orange. Prep. at Springfield, Mass.	*New Haven:* F. J. Markle Co.	10	0.9	7.51	7.70	1.4672	"
23160	Orange for Flavoring. McMonagle & Rogers, Middletown, N. Y.	*Waterbury:* Model Market Co.	25	2.0	6.38	6.60	1.4672	"
23081	Mohican Pure Extract of Orange. The Mohican Co., New York	*Bridgeport:* The Mohican Co.	21	1.9	5.86	6.00	1.4672	"
23068	Sauer's Pure Extract Orange. The C. F. Sauer Co., Richmond, Va.	*New Haven:* J. N. Waterbury & Co.	9	0.9	5.24	5.40	1.4678	"
23044	Sauer's Pure Extract Orange. The C. F. Sauer Co., Richmond, Va.	*Stamford:* South End Cash Grocery	10	1.0	7.05	7.20	1.4678	"
23015	Foss' Pure Extract Orange. Schlotterbeck & Foss Co., Portland, Me.	*Bridgeport:* Village Store Co.	15	1.8	7.80	8.00	1.4675	"
23665	Ambassador Brand Pure Extract of Orange. James Van Dyk Co., New York	*New Haven:* Van Dyk Co.	19	3.1	6.04	6.40	1.4672	"
22309	Williams' Pure Extract of Orange. The Williams & Carleton Co., Hartford	*Hartford:* T. H. Bride	25	2.1	6.64	6.80	1.4681	"

TABLE XV.—ORANGE EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station No.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Polariscope Method.	Precipitation Method.	Refraction of Oil at 30° C.	Color.
23250	Capitol House Pure Extract Orange	*Middletown:* Middletown Cash Grocery	20	2.6	5.16	5.40	1.4672	Turmeric
23691	Carolan's Pure Extract Orange. J. M. Carolan & Co., New York	*Stamford:* N. Y. Cash Grocery	18	2.1	5.35	5.70	1.4675	"
23692	Concentrated Compound Extract of Orange. Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	10	1.8	0.00	0.00	....	Artificial
23084	Howco Pure Flavoring Extracts, Orange.	*Bridgeport:* The Howland Dry Goods Co.	15	2.2	4.55	4.70	1.4675	Natural
23252	Dr. McKee's Concentrated Fruit Extract, Orange. The McKee Medicine Co., Middletown	*Middletown:* The Village Grocery	20	1.9	9.30	9.80	1.4668	Artificial
23182	Essence Orange	*Mystic:* Mutual Tea Co.	15	1.7	*0.30	tr.	....	"
23011	Tropic Brand Concentrated Extract Orange. The							

Peppermint Extract.

Standard peppermint extract is "the flavoring extract prepared from oil of peppermint, or from peppermint, or both, and contains not less than three (3) per cent. by volume of oil of peppermint."

The usual adulterations of this extract are deficiency of oil and the use of artificial color.

Thirteen samples were examined. Four were up to standard and of natural color. Sample 23061 was of the full strength of the U. S. P. preparation. The use of the words "highly concentrated" with sample 23075 is not strictly correct.

Six samples were below standard or illegally labeled. Four contained only traces of the oil and three were artificially colored; in only one case was this stated on the label. Sample 23659 was labeled "one-fourth standard strength, oil peppermint, 2.34%," which statement was untrue. The standard strength referred to was evidently that of the U. S. P. The formula given with sample 23247 was meaningless and misleading. Samples 23693 and 23163 bore the word "concentrated" on the label, although they only contained traces of the oil.

Three samples were legally labeled compounds. Sample 23124 was labeled "10% U. S. standard." As the U. S. P. standard for spirit of peppermint is 10 per cent. oil, and as under the Food and Drug law the U. S. P. is a U. S. standard, the use of the phrase given on the label is misleading, although in this particular case the extract is 10 per cent. of the U. S. standard, 3 per cent.

The average cost of the extracts was 8.3 cents per fluidounce.

The quantity of extract was guaranteed in three samples and these guaranties were satisfied.

Peppermint oil itself varies greatly in rotatory power and in menthol content. The polariscope and the determination of menthol, therefore, give only an approximate idea of the amount of oil present in the extract. In the Mitchell precipitation method the results tend to be low because of the imperfect separation of the oil. Howard's modification of the latter method gives much more satisfactory results, but with this method we have found it difficult to evaporate all of the chloroform and ether without losing some of the volatile oil. The results by this

TABLE XVI.—PEPPERMINT EXTRACT UP TO STANDARD.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz	Peppermint Oil by Volume. Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 90° C.	Color.
23061	Essence Peppermint. Austin, Nichols & Co., New York	*Norwalk:* F. D. Lawton	10	1.2	9.57	11.2	11.4	1.4603	Natural
23071	Pure Extract of Peppermint. Clark Extract Co., West Haven	*West Haven:* D. M. Welch & Son	10	2.0	4.90	4.0	4.4	1.4586	"
22311	Pure Extract Peppermint. Frank E. Harris, Binghamton, N. Y.	*Hartford:* Hartford Public Market	10	1.0	*	6.2	6.8	1.4600	"
23075	†Perfectly Pure Highly Concentrated Flav. Extr. Peppermint	*Bridgeport:* East India Tea Co.	20	2.0	3.14	3.0	2.8	1.4600	"

* Could not read. † Not a "highly concentrated" extract.

TABLE XVII.—PEPPERMINT EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz	Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 90° C.	Color.
23028	Finest Extr. of Peppermint. Acker, Merrall & Condit Co., New York	*Greenwich:* Acker, Merrall & Condit Co.	20	2.1	*	2.2	†	1.4586	Natural
23693	Concentrated Extract of Peppermint. Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	10	1.6	0.0	0.0	0.2	....	Artificial
23183	Essence Peppermint	*Mystic:* Mutual Tea Co.	15	1.7	*	‡1.2	†	....	Natural
23659	Premium Brand Peppermint	*New Haven:* Carlson Tea & Butter Co.	13	1.7	0.50	§0.4	0.2	....	§Artificial
23247	St. John's Extract Peppermint. St. John & Co., New York	*Middletown:* C. A. Allison	15	1.8	0.43	‖0.4	0.8	....	Natural
23163	Gilt Edge Brand Concentrated Extract of Peppermint	*Waterbury:* Yale Tea Co.	10	1.7	0.57	¶0.2	0.4	....	¶Artificial

* Could not read. † Could not effect separation of the oil. ‡ Labeled "3% oil peppermint." § Labeled indistinctly "one-fourth Standard Strength." Formula, 2.34% oil peppermint, artificially colored. ‖ Meaningless formula on back of carton, "70 pts. hydro-alcoholic sol. oil peppermint, 30 pts. aqua." ¶ Formula, essential oil, 1.56%, artificial color, a trace.

TABLE XVIII.—COMPOUND PEPPERMINT EXTRACT LEGALLY LABELED.

Station Number.	Brand	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz	Polariscope Method.	Mitchell's Precipitation Method.	Howard's Method.	Refractive Index of Oil at 90° C.	Color.
23035	A. & P. Peppermint. The Great Atl. & Pac. Tea Co., New York	*Stamford:* Atlantic & Pacific Tea Co.	25	1.9	2.86	3.0	3.8	1.4579	*Artificial
23124	Superior Brand Extract Peppermint. Made at Hartford	*Danbury:* Danbury Grocery Co.	10	1.7	0.29	†tr.	0.4	....	Natural
23122	Sovereign Peppermint Flavoring. The Union	*Danbury:* Union Pacific Tea							

method, therefore, may be a trifle high. In judging of the purity of the extracts examined we have accepted the figures by the Howard method, thus giving the manufacturer the benefit of every doubt.

For details of the method see page 516.

Pineapple Extract.

It is not possible to prepare from the pineapple, raspherry, strawberry and certain other fruits extracts concentrated enough to give the distinctive fruity flavor. Artificial fruit essences composed of compound ethers in varying proportions and combinations are used instead to imitate these fruit flavors. At best they are poor imitations and are apt to produce indigestion and diarrhœa if consumed in quantity. The requirement of the law is clear that these artificial flavors should be sold as such and should not be represented to be "pure fruit flavors."

The thirteen pineapple extracts examined were, with one exception, synthetic or artificial. Sample 23039 showed a faint resemblance to the flavor of the natural fruit; in no sense, however, should it be labeled "highly concentrated." Ten of the samples are passed as legally labeled either as "imitation," "artificial" or "ethereal." There is some question, however, as to compatibility of the words "pure" and "artificial," or "highly concentrated" and "artificial" on the same label. Four of the legally labeled extracts contained artificial color, which was declared in two cases.

Three samples were illegally labeled. Sample 23694, labeled "concentrated compound extract," was a synthetic flavor, artificially colored; sample 23249, labeled "pure concentrated extract," was a synthetic flavor; sample 23228, a synthetic flavor, was labelled "best pineapple" on one side of the carton and "best artificial pineapple flavoring" on the other.

The average cost of these extracts was 8.9 cents per fluidounce.

Six samples were guaranteed as to quantity of extract; sample 23039 showed a slight shortage.

Raspberry Extract.

Six of the seven samples tested were synthetic flavors, three of which were legally labeled. Sample 22314 had the genuine fruit flavor and appears to be a concentrated fruit juice rather than an

TABLE XIX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS LEGALLY LABELED.

Station No.	Brand.	Dealer.	Price per bottle	Capacity of bottle.	Remarks.
			cts.	fl. oz.	
	Banana.				
23025	Burnett's Imitation Banana. Joseph Burnett Co., Boston	*Greenwich:* T. F. Carey	20	2.1	Synthetic flavor, natural color.
	Pineapple.				
23029	Finest Pineapple Flavor, Artificial. Acker, Merrall & Condit Co., New York	*Greenwich:* Acker, Merrall & Condit Co.	20	2.2	" "
23186	Imitation Pineapple. Grand Union Tea Co., Brooklyn, N. Y.	*New London:* Grand Union Tea Co.	20	2.1	" "
23159	Imitation Pineapple Flavoring. McMonagle & Rogers, Middletown, N. Y.	*Waterbury:* Model Market Co.	25	2.0	" "
23662	Pure Extract of Finest Pineapple Flavor Artificial. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	2.0	Synthetic flavor, artificial color.
22312	The Stuart Brand Imitation Flavor of Pineapple. Made at Hartford	*Hartford:* B. A. Bartlett	15	1.8	" " *
23021	Sovereign Imitation Pineapple Flavoring. The Union Pacific Tea Co., New York	*Bridgeport:* Union Pacific Tea Co.	20	2.1	"
23039	Highly Concentrated Pineapple. Van Duzer Extract Co., New York	*Stamford:* Stamford Grocery	10	1.9	Natural flavor (?), natural color.
23105	Artificial Extracts, Highly Concentrated Pineapple. Van Duzer Extract Co., New York	*Ridgefield:* S. D. Keeler	25	2.1	Synthetic flavor, natural color.
23678	Extract of Pineapple (Ethereal). Wightman's, New York	*Bridgeport:* Village Store Co.	15	1.9	Synthetic flavor, artificial color.
23211	High Grade Brand Imitation of Pineapple. Made at Hartford	*Norwich:* The Mohican Co.	17	2.0	" " *

* Artificial color declared on label.

TABLE XIX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS LEGALLY LABELED—*Concluded.*

Station No.	Brand.	Dealer.	Price per bottle.	Capacity of bottle.	Remarks.
	Raspberry.		cts.	fl. oz.	
23284	Baker's Imitation Raspberry Flavor. Baker Extract Co., Springfield and Portland	*Meriden:* Booth's Grocery	20	1.8	Synthetic flavor.
22314	Raspberry Extract. Beach & Clarridge, Boston	*Hartford:* C. H. Strong	25	2.2	Probably natural flavor & color.
23663	Pure Extract of Finest Raspberry Flavor, Artificial. The Mohican Co., N. Y.	*New Haven:* The Mohican Co.	20	1.9	Synthetic flavor, artificial color.
23038	Foss' Imitation Extract Raspberry. Schlotterbeck & Foss Co., Portland, Me.	*Stamford:* J. M. Wassing	25	2.0	"
	Strawberry.				
23030	Finest Strawberry Flavor, Artificial. Acker, Merrall & Condit Co., New York	*Greenwich:* Acker, Merrall & Condit Co.	20	2.1	Synthetic flavor, artificial color.
23285	Baker's Imitation Strawberry Flavor. Baker Extract Co., Springfield and Portland	*Meriden:* Booth's Grocery	20	1.6	" "
23026	English Fruit Extracts, Strawberry, Artificial. Joseph Burnett Co., Boston	*Greenwich:* Knapp & Studwell	25	2.1	" " *
23016	High Grade Brand Imitation Strawberry Flavor. The Carleton Extract Co., Hartford	*Bridgeport:* Batchelder Bros.	20	1.9	" " *
23077	Imitation Strawberry. Grand Union Tea Co., Brooklyn, N. Y.	*Bridgeport:* Grand Union Tea Co.	20	1.9	" " *
23054	Mayflower Extract of Artificial Strawberry. The A. Colburn Co., Philadelphia	*So. Norwalk:* A. F. Beckman	10	0.9	" "
23254	Dr. McKee's Fruit Extract Artificial Strawberry. The McKee Medicine Co., Middletown	*Middletown:* The Village Grocery	20	2.0	" "
23053	Sovereign Artificial Strawberry Flavoring. The Union Pacific Tea Co., New York	*So. Norwalk:* Union Pacific Tea Co.	20	2.2	" "
22313	Artificial Extracts Highly Concentrated Strawberry. Van Duzer & Co., New York	*Hartford:* C. H. Strong	25	2.1	"

* Artificial color declared on label.

TABLE XX.—BANANA, PINEAPPLE, RASPBERRY AND STRAWBERRY EXTRACTS ILLEGALLY LABELED.

Station No.	Brand	Dealer.	Price per bottle.	Capacity of bottle.	Remarks.
	Banana.		cts.	fl. oz	
23229	*Best Banana. Stickney & Poor Spice Co., Boston	*Putnam:* Edward Mullan	10	1.2	Synthetic flavor, natural color.
	Pineapple.				
23694	Concentrated Compound Extract of Pineapple. Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	10	2.0	Synthetic flavor, artificial color.
23249	Pure Concentrated Extract Pineapple. The John T. Doyle Co., New Haven	*Middletown:* O. Thompson & Co.	18	1.9	Synthetic flavor.
23228	†Best Pineapple. Stickney & Poor Spice Co., Boston	*Putnam:* Edward Mullan	10	1.2	"
	Raspberry.				
23060	Bastine's Pure Extracts, Raspberry. Bastine & Co., New York	*So Norwalk:* Raymond & Co	25	1.9	Synthetic flavor, artificial color.
23248	Pure Concentrated Extract Raspberry. The John T. Doyle Co., New Haven	*Middletown:* O. Thompson & Co.	18	1.0	" "
23036	‡Hill's Raspberry, Highly Concentrated. Robert Hill, New York	*Stamford:* Empire State Tea Co.	15	1.9	" "
	Strawberry.				
23076	Clark's Compound Strawberry. Clark Extract Co., West Haven	*West Haven:* D. M. Welch & Son	10	2.0	" "
23188	Clover Brand Pure Flavoring Extracts, Strawberry, Highly Concentrated	*New London:* Jas. P. Kiely	20	1.7	
23018	A. & P. Strawberry Flavor (color trace). The Great Atl. & Pac. Tea Co., New York	*Bridgeport:* Atlantic & Pacific Tea Co.	25	2.0	" "
23185	Extract of Strawberry. Nichols & Harris, New London	*New London:* F. H. Davis & Co.	15	2.0	" "
23210	Fruit Extracts, Highly Concentrated Strawberry. Van Duzer Extract Co., New York	*Norwich:* The Mohican Co.	17	1.9	" natural color.
23106	Williams' Choice Extract of Strawberry. The Williams & Carleton Co., Hartford	*Ridgefield:* S. D. Keeler	20	2.1	" artificial color.

* Labeled "Best Banana" on one side of carton, "Best Artificial Banana Flavoring" on the other side.
† Labeled "Best Pineapple" on one side of carton, "Best Artificial Pineapple Flavoring" on the other side.
‡ Labeled as above on carton, "Artificial Extract of Raspberry" on the bottle.

extract. The use of the words "pure" and "artificial" on the same label in sample 23663 is objectionable. Samples 23060, 23248 and 23036 were sold as pure or concentrated extracts; they were in all cases synthetic flavors artificially colored.

The average cost of these extracts was 11.7 cents per fluidounce. Sample 23663 contained slightly less extract than guaranteed.

Strawberry Extract.

All of the fifteen samples tested, with possibly the exception of sample 23210, were synthetic flavors, artificially colored. Nine were legally labeled "artificial" or "imitation." The other six were illegally labeled either as pure extracts or not clearly designated as compounds.

The average cost was 10.1 cents per fluidounce.

Four samples were guaranteed as to quantity; of these samples 23077 and 23210 showed slight deficiencies.

Wintergreen Extract.

Standard wintergreen extract is "the flavoring extract prepared from oil of wintergreen, and contains not less than three (3) per cent. by volume of oil of wintergreen."

Oil of wintergreen consists almost entirely of methyl salicylate. This is also true of oil of betula or sweet birch, which is frequently substituted for the true oil of wintergreen. The two differ somewhat in odor and taste. Synthetic methyl salicylate is very commonly used instead of either of the above-named oils. It is a matter of extreme difficulty to distinguish these three substances from each other by chemical means. The results reported herewith were obtained by determining the methyl salicylate present and calculating the same in terms of oil of wintergreen, no attempt being made to establish the source of the flavor.

Eleven samples were examined, six of which contained a practical equivalent of 3 per cent. oil of wintergreen and were of natural color. Five samples were below standard or illegally labeled.

Sample 23277 was artificially colored. Sample 23184, which was of U. S. P. strength, was artificially colored. Sample 23660 was labeled on the carton to contain 1.5 per cent. oil, but it contained only 0.89 per cent. and was artificially colored. Sample

TABLE XXI.—WINTERGREEN EXTRACT UP TO STANDARD.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Oil of Wintergreen.	Color.
					%	
22310	Baker's Pure Essence Wintergreen. Baker Extract Co., Springfield and Portland	*Hartford:* Boston Branch Grocery	25	2.1	2.91	Natural.
23187	Clover Brand Pure Flavoring Extracts Wintergreen, Highly Concentrated	*New London:* Jas. P. Kiely	20	2.0	3.39	"
23062	Pure Concentrated Essence Wintergreen. Colonial Perfume & Toilet Co., Detroit	*Norwalk:* F. D. Lawton	10	1.9	3.19	"
23161	Essence Wintergreen. Grand Union Tea Co., Brooklyn, N. Y.	*Waterbury:* Grand Union Tea Co.	20	1.9	3.13	"
23212	A. & P. Flavoring Extracts, Wintergreen. The Great Atlantic & Pacific Tea Co., N. Y.	*Norwich:* Atlantic & Pacific Tea Co.	25	2.0	3.24	"
23076	Perfectly Pure Highly Concentrated Flavoring Extract, Wintergreen	*Bridgeport:* East India Tea Co.	20	2.0	3.20	"

TABLE XXII.—WINTERGREEN EXTRACT BELOW STANDARD OR ILLEGALLY LABELED.

Station Number.	Brand.	Dealer.	Price per bottle, cts.	Capacity of bottle, fl. oz.	Oil of Wintergreen.	Color.
23277	Baker's Pure Essence Checkerberry. Baker Extract Co., Springfield and Portland	*Meriden:* H. E. Bushnell	20	2.0	2.82	Artificial.
23184	Essence Wintergreen. Nichols & Harris, New London	*New London:* F. H. Davis & Co.	15	1.8	5.36	"
23660	*Premium Brand Wintergreen	*New Haven:* Carlson Tea & Butter Co.	13	1.4	0.89	"
23660a	†Premium Brand Wintergreen	*New Haven:* Carlson Tea & Butter Co.	13	1.7	1.59	"
23125	‡Superior Brand Extract Wintergreen. Distributed by Hooker & Co., Hartford	*Danbury:* Danbury Grocery Co.	10	1.8	0.34	Natural.

*Formula on carton, but not on bottle, calls for "Oil Wintergreen, 1.5, ... Coloring, 1."

†Formula calls for "Oil Wintergreen, 2.34, ... Artificially colored." Also labeled indistinctly "one-fourth Standard Strength."

‡The use of the word "Superior" with an extract of this quality is objectionable. The words "10 % U. S. Standard" are also misleading as to its strength.

23660a, a duplicate sample from the same dealer, was labeled to contain 2.34 per cent, but contained only 1.59 per cent. Sample 23125 claimed to be "10 % U. S. standard," which would be 0.30 per cent. It actually contained 0.34 per cent. The sample is wintergreen extract diluted with water and should be so stated on the label.

The average cost was 9.3 cents per fluidounce.

Four samples were guaranteed as to quantity: of these sample 23161 showed a slight deficiency.

For methods of analysis see page 517.

Methods of Analysis.

The details of only those methods which require special comment, or which were modified by us in some particular, are included here.

Alcohol. The volatile oil was found to interfere seriously in the determination of the high percentages of alcohol in ginger extracts. The method adopted was to dilute 15 gms. of the extract with water to 100 c.c. in a 200 c.c. Erlenmeyer flask, add 2.5 gms. of magnesium carbonate and shake thoroughly. Filter through small plaited filter and distil the alcohol from 75 c.c of the filtrate.

Almond Oil. Hortvet's method was used.* Both the gravimetric and volumetric methods were used, and the results differed by only a few hundredths of 1 per cent. The method was very satisfactory and gave concordant results irrespective of the amounts of alcohol and oil which the extracts contained. The presence of hydrocyanic acid, glycerol or sugar did not vitiate the results. If nitrobenzol is present it may be removed by Leach's method before attempting the determination of the benzaldehyde.

Hydrocyanic Acid in Almond Extract.† To a few cubic centimeters of the extract in a test tube add a few drops of a mixture of solutions of ferrous sulphate and ferric chloride, the ferrous salt being in excess. Make alkaline with sodium hydroxide, and add enough dilute hydrochloric acid to dissolve the precipitate formed by the alkali. Presence of a blue coloration or precipitate, due to the formation of Prussian blue, indicates hydrocyanic acid.

Total Solids in Ginger Extract. Weigh from 5 to 10 grms. of extract into a tared flat-bottomed dish and evaporate to apparent dryness at a moderate temperature (there is danger of loss by spurting in samples

* Journ. Ind. and Eng. Chem., 1909, *1*, 87.

† Leach's Food Inspection and Analysis, 1909, 877.

containing high percentages of alcohol). Dry to constant weight in drying oven at the temperature of boiling water.

Solids of Ginger Extract Soluble in Alcohol. Add 15 c.c. of 95 per cent. alcohol to the dried residue ohtained as above. Stir thoroughly with a glass rod and allow to stand for one hour. Wash into a 50 c.c. flash with 95 per cent. alcohol and make up to the mark. Filter the solution through a dry plaited filter, and evaporate an aliquot of 25 c.c. and weigh as for total solids, taking the same precautions to insure a slow evaporation of the alcohol.

Solids of Ginger Extract Soluble in Water. Add 15 to 20 c.c. of water at room temperature to the residue obtained in total solids determination. Stir with glass rod at frequent intervals during three hours. Because of the gummy character of many residues it is sometimes difficult to secure proper contact with the solvent. Wash in a 50 c.c. flask with water and make up to the mark. Filter the solution through a dry plaited filter, and evaporate an aliquot of 25 c.c. and dry to constant weight in a water oven.

Orange Oil. The usual polariscope method was used, dividing the V° by 5.2 to secure per cent. of oil by volume. According to Allen* a correction must be made in the polariscope reading when any other than the standard temperature has been used. At temperatures below 20° C., 0.24° must be subtracted for each degree below 20°, whilst for temperatures above 20° C., 0.22° must be added for each degree to obtain the angular rotation for the standard temperature. One degree of angular rotation equals 2.8835° V., and we have made this correction in each case.

Orange oil was also determined by Mitchell's precipitation method.

Peppermint Oil. The extreme variability in rotatory power of peppermint oil itself makes the use of the polariscope of relatively small value in determining this oil. Mitchell's precipitation method has also been found to be quite uncertain in its results because of the imperfect separation of the oil. We found by a series of experiments that no constant factor for this solubility could be applied, especially in extracts containing less than 5 per cent. of oils. In spirits of peppermint where the content of oil should be 10 per cent., the Mitchell method gave much more satisfactory results.

Howard's modification† was also used and with more satisfactory results, but there is a tendency toward high results because of the difficulty in removing all the ether and chloroform without losing some of the volatile oil. In three prepared solutions containing 1, 2 and 3 per cent. of peppermint oil, by the Howard modification we secured 1.00, 2.40 and 3.40 per cent. respectively.

* Organic Analysis, *2*, pt. 3, 438.

† Leach's Food Inspection and Analysis, 1909, 865.

Oil of Wintergreen. Hortvet's method* of determining methyl salicylate was used. Attempts were made to modify the Mitchell precipitation method by using salt solutions of varying densities, but the heaviness of the oil prevented a satisfactory separation in the Babcock bottles used in the centrifuge method.

ICE CREAM CONES.

During the last year or two the method of serving ice cream in small quantities in cake-like cones has become very popular and the consumption of these cones has become enormous. One firm is reported to put out over a million cones a day during the heated term. Inasmuch as the cones are eaten very largely by children, it is important to determine their composition and whether they contain harmful ingredients.

Twenty-seven samples were examined. These ranged from the small cones, in which a cent's worth of ice cream was sold, to the larger ones, costing five cents when filled with cream. This way of buying ice cream is of course expensive, but is convenient, and if the cones, which are generally eaten, contain no harmful ingredients, their use is not open to serious criticism.

The weight of the cones ranged from 1.1 to 16.9 grams. They cost on the average about five cents per dozen for the small cones to about 17 cents for the largest size.

The cones were submitted to the usual food analysis and were examined also for benzoic, salicylic and boric acids, saccharine and artificial color.

In twenty-two samples no adulteration was detected, although in two of these there was some question as to the addition of coloring matter. One of the adulterated samples contained a coal-tar dye and four boric acid. There is no necessity for using any chemical preservative in the manufacture of the cones, and the presence of the boric acid is probably traceable to the eggs used in making the cones. Whatever the source, its presence in the cones is highly objectionable and is clearly contrary to the law. It is interesting to note that a duplicate purchase of one brand of the cones, containing boric acid, from the same dealer a month later, showed no boric acid. The publicity given to the Federal seizure of cones in New York probably has had its effect.

In composition the cones are quite similar to that of biscuits, as the following averages will show:

* Journ. Ind. and Eng. Chem., 1909, *1*, 90.

TABLE XXIII.—ICE CREAM CONES NOT FOUND ADULTERATED.

Station Number.	Manufacturer.	Dealer.	Average weight of cone, grms	Price per dozen, cts	Water.	Ash.	Protein (N x 6.25).	Crude Fiber	Nitrogen-free Extract.	Ether Extract.	Refractive Index of Fat at 40° C.
24928	Augur Baking Co., New York	*Middletown:* Bergquist Bros.	3.2	12	8.35	1.29	12.13	0.25	74.23	3.75	1.4778
25074	" " " " "	*Mount Carmel:* Thomas O'Neil	3.4	10	11.59	1.15	12.25	0.16	70.49	4.36	1.4756
25115	F. Atwood & Co.	*New Haven:* E. N. Sperry	16.9	12	8.17	1.00	8.50	0.16	80.20	1.97	1.4512
24896	J. A. Beany, New Haven	*New Haven:* H. L. Laviettes	11.5	14	8.03	0.53	8.38	0.28	80.19	2.59	1.4687
24977	Corey & Co., West Haven	*West Haven:* Corey & Co.	13.5	20	5.10	0.39	8.88	0.11	82.06	3.46	1.4720
24976	" " " " "	*West Haven:* Kimberly's News Store	11.6	20	7.29	0.41	8.69	0.09	78.49	5.03	1.4629
24906	Eagle Mfg. Co., Baltimore, Md.	*Hartford:* East Side Lunch	6.7	20	8.19	1.15	7.69	0.24	79.71	3.02	1.4523
25082	Howe & Marks, Highwood	*New Haven:* J. M. Roseff	14.8	12	13.19	0.50	7.58	0.08	77.85	0.80	....
24897	Jaconelli Mfg. Co., Philadelphia, Pa.	*New Haven:* Confectionery, 1271 State St.	1.3	7	9.52	0.64	10.50	0.18	76.77	2.39	1.4759
24929	Kibbie & Co., Springfield, Mass.	*Middletown:* Boston Candy Kitchen	4.8	10	9.45	0.50	11.31	0.23	74.43	4.08	1.4732
25054	J. Marchiony, Hoboken, N. J.	*South Norwalk:* F. W. Woolworth & Co.	3.8	10	9.32	1.07	11.00	0.20	75.95	2.46	1.4663
24980	H. A. Nahass, New London	*New London:* H. A. Nahass	14.7	20	9.31	0.42	9.81	0.16	79.79	0.51	....
25114	New Haven Dairy Co., New Haven	*New Haven:* David Ring	14.6	12	9.40	0.48	7.88	0.18	80.52	1.54	1.4629
25055	Popcorn & Cone Works, Akron, O.	*South Norwalk:* Candy Kitchen	13.8	20	8.93	0.37	6.25	tr.	84.09	0.36	....
24904	Not given	*Hartford:* Holdstock Confectionery	5.1	24	9.27	0.51	12.19	0.10	74.94	2.99	1.4759
24905	" "	*Hartford:* S. Weiner	1.1	5	9.47	1.54	11.13	0.17	76.07	1.62	1.4748
24907	Made in Hartford	*Hartford:* S. Lipman	1.3	12	8.69	1.76	13.00	0.28	74.59	1.68	1.4746
24927	Not given	*Middletown:* Candy Kitchen	4.4	10	9.31	0.96	12.50	0.24	73.92	3.07	1.4735
24894	Made in Hartford	*New Haven:* Rubins, 31 Washington Ave.	1.3	5	9.14	0.87	12.56	0.18	70.38	6.87	1.4685
24981	Not given	*New London:* H. Millson	11.3	20	7.95	0.50	10.00	0.09	79.49	1.97	1.4684
24996	" "	*Norwich:* Olympia Candy Kitchen	4.9	8	10.77	0.50	11.44	0.21	75.63	1.45	1.4752
24978	" "	*West Haven:* Nouget de Montilimar	11.6	20	8.82	0.35	8.38	0.13	81.89	0.43	1.4740

TABLE XXIV.—ICE CREAM CONES ADULTERATED.

Station Number.	Manufacturer.	Dealer.	Average weight of cone, grms	Price per dozen, cts	Water.	Ash.	Protein (N x 6.25).	Crude Fiber	Nitrogen-free Extract.	Ether Extract.	Refractive Index of Fat at 40° C.
24893	*Delzarino, Hartford	*New Haven:* Rubins, 31 Washington Ave.	1.3	5	8.95	1.12	13.44	0.17	70.39	5.93	1.4682
24895	†Not given	*New Haven:* D. Markowitz, 63 Washington Ave.	1.2	10	9.86	0.99	13.19	0.18	74.16	1.62	1.4759
24903	†Brooklyn Cone Co., Brooklyn, N. Y.	*Hartford:* Joe Rates, 135 Albany Ave.	2.9	10	10.63	0.99	12.88	0.18	73.11	2.21	1.4550
24955	†Made in Brooklyn, N. Y.	*Bridgeport:* J. Delbarbieri, 692 Fairfield Ave.	1.1	5	10.00	0.74	13.00	0.19	74.71	1.36	....
25023	†‡Consolidated Water Co. Cones, N. Y.	*Stamford:* Max Myers, 110 Pacific St.	1.2	5	12.21	1.03	12.25	0.26	72.59	1.66	1.4734

* Contains artificial color. † Contains boric acid. ‡ Second sample taken from same dealer one month later contained no boric acid.

	Cones. Average Conn. Samples.	Biscuits. Ave. Wiley's Analyses.
Water	9.29	7.13
Ash	0.81	1.57
Protein	10.62	9.43
Crude Fiber	0.17	0.47
Nitrogen-free Extract	76.55	73.77
Ether Extract	2.56	8.67

There is nothing in the analyses to indicate the use of any ingredient not usually employed in the making of biscuits or similar material. The low percentages of crude fiber show that the popular idea that paper enters into the make-up of the cones is without foundation.

Tests for benzoic and salicylic acids and for saccharine were negative in all cases.

The refractive index of the fat was determined with the idea that it might give some indication as to whether oleomargarine had been used. The refractive index of pure butter at 40° C. ranges from 1.4535 to 1.4565, oleomargarine from 1.4595 to 1.4645, and that of the oil from wheat flour is 1.4796. The indices of the fat of the cones ranged from 1.4512 to 1.4778, and no conclusions can be drawn from this determination.

MINCE MEAT.

The standard for mince meat is as follows:

"*Mince, mince meat,* is a mixture of not less than ten (10) per cent. of cooked, comminuted meat, with chopped suet, apple and other fruit, salt and spices, and with sugar, sirup, or molasses, and with or without vinegar, fresh, concentrated, or fermented fruit juices or spirituous liquors."

The standard permits wide variations in the composition of this material, and a chemical analysis alone is of little value in establishing its purity. The examination was therefore concerned chiefly in determining the nature of the preservative used, if any.

Of the nineteen samples examined, eight were of a semisolid consistence and in general were of the nature required by the standard. The other eleven were compressed into the form of a cake, the binding material generally being flour or starch. Four of these samples, **24029, 23962, 24095** and **23960**, gave no indication on the label as to the added cereal, and under a strict interpretation of the standard would be considered adulterated.

TABLE XXV.—MINCE MEAT NOT FOUND ADULTERATED.*

Station Number.	Brand.	Price per package.	Net weight per package.	Cost per lb.
	Semi-solid.	cts.	oz.	cts.
24030	†Acker, Merrall & Condit Co., N. Y. Amcehat Brand	30	22.4	21.4
24066	†Atmore & Son, Philadelphia. Atmore's	20	24.4	13.1
24084	†Boston Grocery, Meriden. (In bulk)	13	21.8	9.5
24034	†H. J. Heinz Co., Pittsburgh, Pa. Heinz	20	14.7	21.8
24106	Oneida Community Limited, Oneida, N. Y. Home Grown and Home Preserved	60	38.1	25.2
24108	Whipple Coöperative Co., Natick, Mass. Grandmother's	35	43.7	12.8
	In compressed cake.			
24029	Armour & Co., Chicago. Veribest	10	11.8	13.6
24049	Atmore & Son, Philadelphia. Atmore's Condensed	9	11.6	12.4
24059	Brownell & Field Co., Providence, R. I. Autocrat Brand	10	11.2	14.3
24085	Lewis DeGroff & Son, New York. Health Brand	10	11.4	14.0
23962	Great Atlantic & Pacific Tea Co., New York. A. & P. Brand	9	11.0	13.1
24094	H. C. Gutchess, Port Byron, N. Y. Gutchess' Imperial Condensed	10	11.0	14.5
24058	The Humphrey Cornell Co., New London. Laurel Brand	10	10.8	14.8
24095	Libby, McNeill & Libby, Chicago. Libby's Cond.	10	11.8	13.6
23961	The Mohican Co., N. Y. Mohican Brand Condensed	9	11.1	12.0
24033	Merrell-Soule Co., Syracuse, N. Y. None Such	10	11.6	13.8
23960	Whipple Coöperative Co., Natick, Mass. Grandmother's	9	11.7	12.3

*Contained no benzoic, salicylic or boric acid. See page 521.
† Considerable fat present indicating use of suet.

TABLE XXVa.—MINCE MEAT COMPOUND OR ADULTERATED.

	Semi-solid.			
24069	‡The Acme Mince Co., Bristol, Conn. Acme High Grade Pie Fillings	16	16.7	15.3
24107	§George Chitty, New Haven. (In bulk)	9	17.7	8.1

‡ Labeled to contain 0.10 % sodium benzoate and colored with caramel; 0.10 % benzoate found.
§ Adulterated; contained 0.12 % sodium benzoate, not stated on label.

All the samples were tested for benzoic, sulphurous, salicylic and boric acid. The two latter were found in no case. Two samples contained sodium benzoate. In **24069** 0.10 per cent. was guaranteed on the label, and exactly that amount was found on analysis. In **24107**, which was sold in bulk and unlabeled, 0.12 per cent. was found, and the sample is, therefore, adulterated.

Sulphurous acid ranged from 1.43 to 8.12 mgms. per 100 gms. of material. It is recognized that traces of sulphurous acid in meat products should be ignored, as unpreserved meats may give slight reactions for this acid, probably due to a partial decomposition of proteins. Mentzel* asserts that 4 mgms. per 100 gms. may be due to this cause. Only two of the samples examined materially exceed this limit, **24066** and **24084**, which contain 7.35 and 8.12 mgms., respectively. These quantities would seem to be excessive, although we have not classed the samples as adulterated.

Only four of the samples, **24030**, **24066**, **24084** and **24034**, contained any considerable amount of fat, indicating that most of the samples contained little, if any, suet. In certain samples the amount of meat present was a vanishing quantity, the samples consisting chiefly of raisins or currants, and in one case largely of a puffed cereal.

The cost per pound of the semisolid mince meat ranged from 8.1 to 25.2 cents, but in the compressed form it was much more uniform, ranging from 12.0 to 14.8 cents. Quality is an important factor in a material like mince meat, and in many of the samples the better quality is reflected by the higher price asked, although this does not follow in every case.

KETCHUP.

The standard for this material is as follows:

"*Catchup* (*ketchup, catsup*) is the clean sound product made from the properly prepared pulp of clean, sound, fresh, ripe tomatoes, with spices and with or without sugar and vinegar; *mushroom catchup, walnut catchup, et cetera,* are catchups made as above described, and conform in name to the substances used in their preparation."

This standard gives no analytical maxima or minima, and the main purpose of the present examination was to fix, if possible, certain analytical standards whereby the purity of the ketchup in question might be established. The standard permits the use of no chemical preservative, no substitute for sugar, such as glucose, nor any foreign coloring matter. Furthermore, accord-

ing to the standard, the use of the word "ketchup" without any qualifying term means that made from tomatoes.

Seventy-four samples, representing fifty-six manufacturers, or jobbers, were analyzed. The following table gives the names of the manufacturers and the brands, together with the exact phraseology of the label:

TABLE XXVI.—LIST OF BRANDS AND MANUFACTURERS.

23719. American Pickling Co., Providence, R. I. *American Brand Ketchup.* Preserved with one-tenth of one per cent. Benzoate of Soda.

23724. American Pickling Co., Providence, R. I. (Manufactured for). *Standard Ketchup.* Ninety per cent. Fruit Pulp, two and one-half per cent. Pure Spices, two per cent. Sugar, two and one-half per cent. Wheat Flour, two and four-tenths per cent. Vinegar, one-tenth of one per cent. Benzoate of Soda, Trace of Vegetable Color. (Blown in bottle, "H. J. Heinz Co.")

23707. Anderson Preserving Co., Camden, N. J. *Tomato Ketchup.* The contents of this package are preserved with three-hundredths per centum of Sodium Benzoate and are warranted not injurious to health.

23690. C. Andresen & Co. *Home Made Long Island Tomato Catsup.* Made from Red Ripe Tomatoes, pure Spices, and granulated Sugar. Preserved with Benzoate of Soda with a trace of artificial coloring. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23758. Austin, Nichols & Co., New York (Distributors). *Lion Brand Ketchup.* Benzoate of Soda one-tenth of one per cent, Compound of Tomatoes, Tomato Trimmings, Salt, Sugar, Vinegar, Onions and Spices.

23717. Austin, Nichols & Co., New York. *Sunbeam Brand Tomato Catsup.* Preserved with one-tenth of one per cent. of Sodium Benzoate.

23696. Beech-Nut Packing Co., Canajoharie, N. Y. *Beech-Nut Brand Tomato Catsup.* Made from whole, red, ripe tomatoes, vinegar, sugar, spices, salt and onions.

23723. Bishop & Co., Los Angeles, San Francisco, New York. *Bishop's California Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23631. P. F. Bowe, Waterbury, Conn. *Bowe Brand Tomato Catsup.* This Catsup is made from tomatoes and is free from coloring. Flavored with pure spices, salt, sugar and distilled vinegar; preserved with one-tenth of one per cent. of benzoate of soda. (Descriptive matter in fine type.)

23639. P. F. Bowe, Waterbury, Conn. *Eagle Brand Catsup.* None Better for Quality. (Same descriptive matter as on 23631 in fine type.) (Blown in bottle, "Homer's California Ginger Brandy.")

23633. P. F. Bowe, Waterbury, Conn. *Perfection Tomato Catsup.* This catsup is made from tomatoes, is free from coloring and preserved with one-tenth of one per cent. of Benzoate of Soda. (Descriptive matter in fine type.)

23647. Joseph Campbell Co., Camden, N. J. *Campbell's Tomato Ketchup.* Seven and one-half ounces net weight.

23710. R. H. Chance's Sons, Philadelphia. *Home Brand Tomato Ketchup.* Free from all artificial coloring and preserved with one-tenth of one per cent. Benzoate of Soda. Made from tomatoes, pure spices, vinegar and sugar.

23706. R. H. Chance's Sons, Philadelphia. *Table Talk Tomato Ketchup.* (Same descriptive matter as on 23710.)

23646. Columbia Conserve Co., Indianapolis, Ind. *Columbia Tomato Catsup.* Made from fresh, ripe, whole tomatoes (from which the skins, cores and seeds have been removed), granulated sugar, salt, distilled vinegar, spices and onions.

23718. H. P. Cornell Co., Providence, R. I. (Packed for). *Shiloh Tomato Ketchup.* Free from all artificial coloring and preserved with one-tenth of one per cent. Benzoate of Sodium. This ketchup is made from tomatoes, pure spices, vinegar and sugar.

23682. Cruikshank Bros. Co., Pittsburg, Pa. *Cruikshank's Tomato Ketchup.* One-tenth of one per cent. Benzoate of Soda. Made from fresh ripe tomatoes, pure spices, granulated sugar, vinegar and salt.

23722. Cruikshank Bros. Co., Pittsburg, Pa. *Home Made Tomato Ketchup.* Made from red ripe tomatoes, pure spices, granulated sugar and salt. Contains one-tenth of one per cent. Benzoate of Soda.

23653. Curtice Brothers Co., Rochester, N. Y. *Blue Label Tomato Ketchup.* Guaranteed free from artificial coloring or any injurious substances. Contains one-tenth of one per cent. Benzoate Soda.

23632. Lewis De Groff & Son, New York (Packed for). *Red Jacket Catsup.* Made from Tomatoes, Pure Spices, Salt, Sugar, Vinegar and Vegetables. Preserved with one-tenth of one per cent. Benzoate of Soda.

23699. The John T. Doyle Co., New Haven, Conn. *Blue Bell Brand Catsup.* Made from portions of Tomato and Apple. Contains one-tenth of one per cent. of benzoate of soda, one one-hundredth per cent. of color, one one-hundredth per cent. of saccharine.

23655. The John T. Doyle Co., New Haven, Conn. *Doyle's Country Club Tomato Catsup.* Made with care from the best material. Benzoate of Soda one-tenth of one per cent.

23656. The John T. Doyle Co., New Haven, Conn. *East Rock Brand Catsup.* (Same descriptive matter as on 23699.)

23702. The R. N. Fitzgerald Co., Hartford, Conn. (Packed for). *Bon Ton Tomato Catsup.* Contains one-tenth of one per cent. benzoate of soda.

23641. The R. N. Fitzgerald Co., Hartford, Conn. (Packed for). *Mascot Brand Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda. Not Artificially Colored.

23713. The E. C. Flaccus Co., Wheeling, W. Va. *Ohio Valley Preserving Co.* (picture of tomato) *Ketchup.* Natural color. Made from choice, ripe tomatoes and pure spices. Preserved with one-tenth of one per cent. Benzoate Soda.

23726. The L. A. Gallup Co., Norwich, Conn. (Put up expressly for). *Jack Dalton, Jr. Catsup.* Preserved with one-tenth of one per cent. Benz. of Soda. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23687. The Great Atlantic and Pacific Tea Co. (Packed for). *Tomato Ketchup.* Prepared from tomatoes, distilled vinegar, granulated sugar, salt, onions and spices. Prepared with one-tenth of one per cent. Benzoate of Soda, not artificially colored.

23686. E. C. Hazard & Co., New York. *Hazard's Shrewsbury Tomato Ketchup.* Made from ripe tomatoes without fermentation. $1000 will be paid to any one who shows that it contains artificial coloring, chemical preservatives or other impurities.

23695. H. J. Heinz Co., Pittsburg, Pa. *Heinz Tomato Ketchup.* Contains no artificial preservative or coloring matter.

23728. Chas. L. Hirsh & Co., New York (Prepared for). *Crescent Brand Catsup.* Uncolored. Tomatoes seventy-eight, Cereals eighteen, Spices three and nine-tenths, Benzoate one-tenth. (Blown in bottle, "Deep Spring Tennessee Whiskey.")

23640. The Horton-Cato Mfg. Co., Detroit, Mich. *Royal Tomato Catsup.* Made from selected whole fresh tomatoes and finest spices. Contains one-tenth of one per cent. Benzoate Soda.

23721. The Humphrey Cornell Co., New London, Conn. (Packed for). *Best Yet Brand Catsup.* (Same descriptive matter as on 23699.)

23771. The Jersey Packing Co., Cincinnati, Ohio. *Manhattan Club Tomato Ketchup.* Not artificially colored. Contains tomatoes, pieces of tomatoes, sugar, salt, vinegar, corn syrup, onions, garlic and spices.

23644. The Jersey Packing Co., Cincinnati, Ohio (Manufactured for). *Sunny Side Tomato Ketchup.* (Same descriptive matter as on 23771.)

23714. Keystone Pickle Works, Philadelphia. *Stohrer's Keystone* (picture of tomato) *Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23705. The E. S. Kibbe Co., Hartford, Conn. (Packed for). *Winner Brand Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23712. Francis H. Leggett & Co., New York (Distributed by). *Windsor Brand Tomato Catsup.* Prepared from tomatoes, spice, sugar, salt, vinegar and garlic. Preserved with one-tenth of one per cent. Benzoate of Soda.

23698. LeRoy Packing Co., Boston, Mass. *Red Berry Tomato Catsup.*

23648. Jas. J. Longhery & Co., Boston, Mass. *LeRoy Extra Quality Tomato Catsup.* One-tenth of one per cent. benzoate of soda.

23704. Libby, McNeill & Libby, Chicago. *Libby's Tomato Catsup.* Contains one-tenth of one per cent. Benzoate of Soda.

23727. W. H. Mansfield & Co., Putnam, Conn. (Prepared for). *Tomato Catsup, Monogram Brand.* Preserved with one-tenth of one per cent. Benzoate of Soda. This catsup is made from fresh ripe tomatoes, salt, granulated sugar, onions, distilled vinegar and spices.

23703. Mansfield, Witham & Co., Lowell, Mass. *Spindle City Ketchup.* Preserved with one-tenth of one per cent. of benzoate of soda.

23654. McMechen Preserving Co., Wheeling, W. Va. *Nail City Brand* (picture of tomato) *Catsup.* Contains one-tenth of one per cent. of Benzoate of Soda.

23684. McMechen Preserving Co., Wheeling, W. Va. *Old Virginia Catsup.* Made from selected ripe tomatoes, granulated sugar, salt, pure spices, grain vinegar. Preserved with one-tenth of one per cent. Benzoate of Soda. Not artificially colored.

23649. McMechen Preserving Co., Wheeling, W. Va. *Parker House Brand Catsup.* (Same descriptive matter as on 23684.)

23651. Miner, Read & Garrette, New Haven, Conn. (Manufactured for). *None Such Brand Tomato Ketchup.* Made from tomatoes, gran. sugar, onions, pure spices, salt and vinegar. Preserved with one-tenth of one per cent. benzoate of soda.

23657. The Mohican Co., New York. *Mohican Brand Tomato Catsup.* This condiment is prepared from selected ripe tomatoes, flavored with distilled vinegar, sugar and choice spices, and contains one one-thousandth benzoate of soda. No artificial coloring used.

23688. Fred C. Orrell, Stamford, Conn. *The Celebrated White Label Catsup.* Made from Tomato Pulp, Salt, Vegetables, Sugar, Spices, Vinegar and Preserved with Benzoate of Soda. Free from artificial coloring.

23711. Jas. G. Powers & Co., New York. *20th Century Tomato Catsup.* Prepared from Tomatoes, Sugar, Corn Syrup, Distilled Vinegar, Onions, Salt and Spices and Preserved with one-tenth of one per cent. Soda Benzoate.

23782. The Pressing & Orr Co., Norwalk, Ohio. *Omega Brand Tomato Catsup.* Made from Tomatoes and Parts of Tomatoes, Vinegar, Sugar, Salt and Spices. One-tenth of one per cent. Benzoate of Soda.

23716. The Pressing & Orr Co., Norwalk, Ohio. *Winorr Tomato Catsup.* Made from fresh ripe tomatoes, vinegar, sugar, salt and pure spices; to prevent fermentation one-tenth of one per cent. Benzoate of Soda is used.

23681. E. Pritchard, New York and Bridgeton, N. J. *Pride of the Farm Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Free from artificial color. Is made of choice tomatoes, the finest spices, onions, distilled vinegar, granulated sugar and salt.

23768. The Pyle & Tomlinson Co., Bridgeport, Conn. (Packed expressly for). ***American Brand*** (picture of tomato) *Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda.

23683. Rafferty & Hosier, New York. *Club House Brand Catsup.* Prepared from Tomato Pulp, Sugar, Dist. Vinegar, Onions, Salt and Spice and preserved with one-tenth of one per cent. Soda Benzoate.

23767. M. Schoenberg & Co., New York. *The Celebrated White Label Tomato Catsup.* (Same descriptive matter as on 23688.)

23658. M. Schoenberg & Co., New York. *Long Island Delight Brand* (picture of tomatoes)*Catsup.* Free from artificial coloring, made from tomatoes, salt, spices, vegetables, and preserved with one-tenth of one per cent. benzoate of soda. (Blown in bottle, "Cruikshank Bros., Allegheny, Pa.")

23689. John S. Sills & Sons, New York (Packed for). *Imperial Home Made Tomato Catsup.* Prepared from Tomatoes, Distilled Vinegar,

Gran. Sugar, Onions and Pure Spices. Prepared with one-tenth of one per cent. Benzoate of Soda.

23685. The T. A. Snider Preserve Co., Cincinnati, Ohio. *Snider's Home Made Catsup.* Prepared from fresh, ripe tomatoes without fermentation. Not artificially colored. Contains one-tenth of one per cent. benzoate of soda.

23636. Sprague, Warner & Co., Chicago (Distributers). *Richelieu Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate Soda. Not Artificially Colored.

23635. Squire Dingee Co., Chicago. *Squire Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Not Artificially Colored.

23643. The Standard Co., Hartford, Conn. (Distributed by). *Gold Leaf Tomato Ketchup.* Capitol City Pickle House. Preserved with one-tenth of one per cent. of Soda Benzoate. (Blown in bottle, "H. J. Heinz Co.")

23628. The Standard Co., Hartford, Conn. (Distributed by). *Tomato Catsup.* Preserved with one-tenth of one per cent. of Soda Benzoate.

23637. Stoddard, Gilbert & Co., New Haven (Put up expressly for). *High Grade Brand Catsup.* (Same descriptive matter as on 23699.)

23629. David Trubee Co., Bridgeport, Conn. (Packed for). *"Our Own" Ketchup.* Prepared with one-tenth of one per cent. Benzoate of Soda. (Blown in bottle, "Pride of the Farm Tomato Catsup.")

23634. David Trubee Co., Bridgeport, Conn. (Packed for). *"Seaside" Catsup.* Preserved with one-tenth of one per cent. Benzoate of Soda.

23652. The Van Camp Packing Co., Indianapolis, Ind. *Van Camp's Tomato Catsup.* Ingredients:—Tomatoes, Sugar, Vinegar, Salt, Cloves, Allspice, Cayenne Pepper, Onions, and one-tenth of one per cent. of Benzoate of Soda. Net weight about 16 oz.

23638. Waterbury Pickling Co., Waterbury, Conn. *Pride of Connecticut Tomato Ketchup.* Made from tomatoes, pure spices and vinegar, preserved with one-tenth of one per cent. of Benzoate of Sodium.

23630. The J. Weller Co., Cincinnati, Ohio. *Hoffman House Ketchup* (picture of tomato). Ingredients:—Tomatoes, Sugar, Vinegar, Salt, Cloves, Allspice, Cayenne Pepper, Onions and one-tenth of one per cent. of Benzoate of Soda.

23783. Geo. Wienhusen, New Haven, Conn. (Put up expressly for). *Pure Food Brand Catsup.* (Same descriptive matter as on 23699.)

23650. R. C. Williams & Co., New York. *New England Brand Tomato Catsup.* Prepared from Tomatoes, Spice, Sugar, Onions, Salt, and Vinegar. Preserved with one-tenth of one per cent. Benzoate of Soda.

23709. The Williams Bros. Co., Detroit, Mich. *Waldorf Brand Tomato Catsup.* Prepared with one-tenth of one per cent. Benzoate of Soda. Contains tomatoes, sugar, salt, vinegar and spices.

23642. (No manufacturer given.) *Yellow Label Tomato Ketchup.* Contains one-tenth of one per cent. Benzoate Soda, Garlic, Vinegar, Tomatoes, Salt, Spices and Granulated Sugar. (This sample had no cork in the bottle; the catsup was in direct contact with the metal cap.)

23645. (No manufacturer given.) *Ketchup* (picture of tomato). Tomato Pulp, Vinegar, Pure Spices, Sugar. Free from Artificial Color. Preserved with one-tenth of one per cent. Benzoate of Soda.

The Manufacture of Ketchup.

Bitting* has made an exhaustive study of the methods of manufacture used in this country. The process consists "essentially in reducing tomatoes to pulp, removing the skins, seeds, hard parts and stems, adding salt, sugar, condiments and vinegar to suit the taste and cooking to a proper consistency." The selection and preparation of stock, pulping, cooking and seasoning, evaporating and finishing, bottling and processing are all discussed in detail in the bulletin referred to in footnote. The following extract is of interest in connection with much of the present-day discussion as to the relative merits of benzoated, and non-benzoated, ketchups:

"Whole or ground spices, or acetic acid or oil extracts of the spices may be added to the pulp in such proportion as the particular brand demands. The spices most used are cloves, cinnamon, mace, and cayenne pepper; but paprika, pepper, mustard, cardamon, coriander, ginger, celery and allspice are used by some manufacturers. When whole spices are used, it is the practice to suspend them in a cloth bag or wire basket, and to take them out after boiling. They tend to darken the color of the ketchup, a result considered undesirable by some. The ground spices are used sparingly, with the exception of cayenne pepper. The acetic acid extracts of spices are used because they are economical and give a brighter red color than is obtained by the whole spice. The oil extracts produce no discoloration, but they are the most expensive and give an objectionable flavor. Hungarian sweet paprika is now quite largely used and adds to the color as well as to the flavor. Sugar, salt and vinegar are added in such proportion as may be desired, and in some brands onions and garlic are used."

The conditions under which ketchup is made at some of the better factories leave little to be desired. High-grade materials are used, the utmost cleanliness is practiced at all stages of manufacture, and the containers are thoroughly sterilized. The other extreme, representing the great bulk of the ketchup found on the market, is thus described by Bitting:

"The material is not whole ripe tomatoes, but consists of the waste of the canning factory, commonly designated as 'trimming stock,' including

* U. S. Department of Agriculture, Bur. of Chem., Bull. 119.

the green, moldy, broken, rotten and generally unsalable tomatoes, the skins, cores and stems from the peeling tables, and the surplus juice from the filling machine, all of which may be allowed to stand during the day and be run through the cyclone in the evening. At the end of the season, the frosted and half-ripe fruits may be used. . . . The pulp is put up in barrels, preserved, and allowed to stand, possibly in the sun, until a sufficient quantity has accumulated for shipment. . . . The sanitary condition of the factory may be poor, the handling of the goods be unclean, the spices be the refuse from the spice houses, the sugar be of the cheapest grade, and the bottles be only rinsed or be used without even that precaution. The ketchup is a concoction so heavily spiced with hot spices that the tomato flavor is lost and might as well be anything else. The color is normally dirty brown."

Labeling of Ketchup.

Since the passage of the Federal Pure Food law much improvement has been noted in the labeling. While deceptive practices are still sometimes employed in failing to make clear the presence of chemical preservatives, on the whole the labels give a fairly accurate idea as to the quality of the material. This statement does not apply to the amounts of sodium benzoate guaranteed, on the label, which are notoriously misleading, the usual formula "one-tenth of one per cent." generally being meaningless and apparently intended to be so.

The brand itself is the best guaranty of good quality. Price alone is not invariably a safe factor, nor is the absence of benzoate in all cases evidence of superior quality.

The Use of Chemical Preservatives.

It has been conclusively demonstrated by the Bureau of Chemistry and by several of the leading manufacturers, that the use of chemical preservatives in ketchup is totally unnecessary, provided good, ripe stock is used, clean methods of manufacture are followed and the material is thoroughly sterilized at the time of bottling. Notwithstanding these facts, however, the great majority of manufacturers continue to use a chemical preservative, generally benzoate of soda, in their products. In spite of the judgment of the Referee Board that the use of benzoate of soda in food products is not attended by injurious effects on the consumer, there is evidence to the contrary, and it would seem that where there is some doubt, as there undoubtedly is in this

instance, as to the injurious effect of the preservative, it should be interdicted, especially when its use has been proved to be unnecessary. Unfortunately the Connecticut law is so closely modeled after the Federal law, that any interpretation or ruling that affects the one affects the other. Accordingly, under the present regulations the use of benzoate of soda in food products is permitted in this state, but its presence must be clearly stated on the label, together witb its amount. As already stated, the usual quantity guaranteed is one-tenth of one per cent., but from the experience of this and other states it is evident either that the manufacturers do not know the quantity they are using or deliberately intend to deceive the consumer. Of the sixty-seven benzoated ketchups reported in this examination, fifty-two contained an excess of benzoate over what was claimed on the label, in some cases over three times as much.

Chemical Composition of Ketchup.

Few complete analyses of ketchup have been published, most analysts usually being content with a determination of the preservative present. The rather elaborate system of analysis used in tbis examination was adopted chiefly with the hope that chemical data might afford a means of determining purity. Hortvet* has suggested that determinations of salt-free ash, crude fiber and insoluble solids might be of value for this purpose.

In a material of such complex and variable nature as ketchup, wide variations in composition are to be expected. It would seem, however, that certain of the chemical characteristics of the tomato should still be found in the manufactured product. As a natural starting point a number of fresh tomatoes were separated as completely as possible into pulp, skin and seeds, and the separate portions analyzed. The variety of tomato used would naturally affect to some extent the relative proportions of these ingredients, and the figures obtained must not be considered as conclusive for all tomatoes. It is believed, however, that they fairly represent average ripe tomatoes of medium size. The following proportions were obtained:

* Pure Products, 5, 529.

	Original Substance. gms.	Air-dry Substance. gms.	Per Cent. of Tomato.
Whole tomatoes	1455	70.75	.....
Pulp and juice	1237	51.00	85.02
Seeds	75	9.75	5.15
Skins	143	10.00	9.83

That is, the pulp and juice make up about 85 per cent. by weight of the whole tomato.

Below are given the complete analyses of the pulp, seeds and skins and the whole tomato.

	In Original Fruit.				Water-free Basis.			
	Whole Fruit.	Pulp.	Seeds.	Skin.	Whole Fruit	Pulp.	Seeds.	Skin.
Water	95.63	96.38	87.45	93.54	----	----	----	----
Ether Extract	0.27	0.09	3.38	0.11	6.18	2.49	26.93	1.70
Crude Fiber	0.46	0.22	1.93	1.75	10.53	6.08	15.38	27.09
Protein	0.85	0.65	3.89	0.97	19.45	17.96	31.00	15.02
Ash	0.42	0.41	0.44	0.48	9.61	11.33	3.51	7.43
Nitrogen-free Extract	2.37	2.25	2.91	3.15	54.23	62.14	23.18	48.76
Water-Soluble Solids	2.93	2.98	2.25	2.84	67.05	82.32	17.93	43.96
Ratios 1:								
Insoluble Solids to Total Solids	3.0	5.7	1.2	1.8	----	----	----	----
Nitrogen to Fiber	3.4	2.1	3.1	11.3	----	----	----	----
Nitrogen to Ash	3.1	4.0	0.7	3.1	----	----	----	----
Nitrogen to Insoluble Solids	10.6	6.2	16.5	23.4	----	----	----	----
Nitrogen to Total Solids	32.2	34.8	20.2	41.7	----	----	----	----
Fiber to Ash	0.9	1.9	0.23	0.27	----	----	----	----
Fiber to Insoluble Solids	3.1	2.9	5.3	2.1	----	----	----	----
Fiber to Total Solids	9.5	16.4	6.5	3.7	----	----	----	----
Ash to Insoluble Solids	3.4	1.6	23.4	7.5	----	----	----	----
Ash to Total Solids	10.6	8.8	28.5	13.5	---	----	----	----

In studying the above analyses we find that each of the various parts of the tomato possesses some striking characteristics of composition. In the pulp the insoluble solids are low, ash high, fiber low, and protein medium. In the seeds the fiber is medium, the protein high, the ash low, and the insoluble solids very high. In the skin the insoluble solids are high, the fiber high, the protein low, and the ash medium. The application of these ratios in judging the quality of a ketchup will be considered in a later section.

Inasmuch as there are no fixed standards of composition at present for this material, the samples have been grouped in our

TABLE XXVII.—KETCHUPS NOT CONTAINING SODIUM BENZOATE.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material.											Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
					Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein, (Nx6.25).	Acetic Acid.	Polariscope. Direct.	Polariscope. After Inversion.	Polariscope. Temperature.				
				cts.															
23696	Beech-Nut	25	480	23.6	18.51	1.65	2.40	1.57	0.83	0.39	1.56	1.20	0.40	—4.40	21	3.63	10.57	†0.04	
23647	Campbell's	10	237	19.6	15.16	2.06	3.26	2.47	0.79	0.48	1.69	0.85	—2.60	—2.62	21	0.00	8.51	1.22	
23646	Columbia	25	481	23.6	23.21	1.79	4.02	2.85	1.17	0.41	2.44	1.83	....	....	..	...	....	....	
23686	Hazard's	10	440	10.3	15.95	1.63	3.77	3.00	0.77	0.35	1.44	1.20	—1.80	—3.08	21	0.97	9.07	0.35	
23695	Heinz	30	529	25.7	32.49	2.09	3.98	3.05	0.93	0.42	2.13	1.98	2.00	—7.70	21	7.34	17.48	1.14	
23771	Manhattan Club ..	10	437	10.4	28.23	2.19	3.59	2.54	1.05	0.41	1.38	1.14	27.20	23.10	23	3.13	*13.75	5.97	† Contains glucose.
23644	Sunny Side	10	453	10.0	28.10	2.56	3.37	2.33	1.04	0.48	1.69	1.26	25.00	22.88	23	1.62	*13.36	7.58	† Contains glucose.

* Glucose. † Stated on the label.

TABLE XXVIII.—KETCHUPS CONTAINING SODIUM BENZOATE NOT IN EXCESS OF AMOUNT CLAIMED.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material. Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polariscope. Direct.	Polariscope. After Inversion.	Polariscope. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts.																	
23631	Bowe	10	499	9.1	11.32	2.58	1.69	0.71	0.98	0.63	1.25	0.84	0.10	0.08	−0.80	−1.98	21	0.90	5.56	1.29	Small amount of cereal starcl
23710	Home	10	424	10.7	15.35	2.77	3.00	2.37	0.63	0.51	1.38	1.14	0.10	0.04	−0.80	−2.42	22	1.23	6.75	2.48	
23718	Shiloh	10	408	11.1	14.50	2.50	2.69	2.12	0.57	0.57	1.25	0.93	0.10	0.04	2.00	0.66	22	1.02	*0.56	8.41	Contains glucose; no place manufacture
23682	Cruikshank's	10	241	18.8	19.21	2.47	2.97	2.11	0.86	0.50	1.50	1.62	0.10	0.10	−1.20	−4.18	21	2.25	11.29	0.70	
23632	Red Jacket	10	426	10.6	17.88	2.08	3.13	2.06	1.07	0.47	1.25	0.60	0.10	0.07	1.00	−3.52	21	3.42	7.92	1.69	No place of manufacture
23702	Bon Ton	10	452	10.0	17.33	2.15	1.61	0.85	0.76	0.57	1.63	0.96	0.10	0.09	1.20	−4.84	21	4.57	11.03	+2.08	No place of manufacture
23713	Ohio Valley Pres. Co.	15	467	14.6	18.65	2.95	4.31	2.71	1.60	0.69	1.63	1.68	0.10	0.05	3.00	−3.08	22	4.62	5.35	2.05	Benzoate not stated on main la
23714	Stohrer's	5	227	10.0	15.74	2.46	2.98	2.25	0.73	0.56	1.38	1.44	0.10	0.07	4.40	3.53	22	0.66	*2.14	8.02	Contains glucose
23705	Winner	10	443	10.2	17.53	1.59	3.12	2.25	0.87	0.40	1.63	0.72	0.10	0.10	1.40	−3.73	21	3.88	8.12	0.38	No place of manufacture
23681	Pride of the Farm	10	335	13.5	12.76	2.86	2.36	1.67	0.69	0.54	1.75	1.29	0.10	0.05	−1.80	−1.76	21	0.03	5.99	2.09	
23768	American Beauty	10	446	10.2	14.17	1.99	2.75	1.82	0.93	0.36	1.31	0.66	0.10	0.08	1.40	−2.86	22	3.24	6.12	0.39	No place of manufacture
23685	Snider's	18	470	17.4	18.78	2.10	4.22	3.39	0.83	0.35	1.56	0.90	0.10	0.07	−0.20	−3.30	21	2.35	8.35	1.95	
23628	Tomato Catsup (Standard)	10	738	6.1	11.02	1.90	3.26	2.52	0.74	0.50	1.44	1.26	0.10	0.10	0.60	−0.88	21	1.12	1.70	3.00	Excess of salt; no place of m
23638	Pride of Conn.	10	422	10.8	20.67	3.01	1.70	0.97	0.73	0.77	1.31	1.32	0.10	0.07	10.80	4.84	21	4.51	*3.60	8.78	Glucose; cereal starch
23630	Hoffman House	10	453	10.0	19.20	3.24	2.93	1.99	0.94	0.47	1.88	1.50	0.10	0.09	−1.60	−2.86	21	0.95	8.35	4.62	

* Glucose.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material. Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts																	
23719	American	10	405	11.2	11.64	2.94	2.67	1.78	0.89	0.52	0.81	0.78	0.10	0.15	4.40	4.40	22	0.00	*2.51	5.13	Excess of benzoate; glucose and artificial color.
23724	Standard	5	289	7.8	18.39	6.07	2.40	1.43	0.97	0.33	1.00	0.96	0.10	0.25	4.80	—0.66	20	4.12	*0.39	10.15	Excess of benzoate; †artificial color; no place of manufacture; †much starch.
23707	Anderson	10	462	9.8	7.27	2.05	2.65	2.10	0.55	0.44	0.94	0.84	0.03	0.10	1.40	—1.32	21	2.06	2.16	+0.98	Excess of benzoate and salt; artificial color.
23690	Home Made Long Id.	10	426	10.6	16.40	2.88	4.89	4.04	0.85	0.46	1.56	1.38	?	0.13	....	....	..	...	...	....	†Artificial color; excess of salt; amount of benzoate not stated on label.
23758	Lion	10	447	10.1	18.00	2.90	4.60	3.37	1.23	0.70	1.56	1.20	0.10	0.15	1.00	—2.42	22	2.60	5.32	3.22	Excess of benzoate; no place of manufacture.
23717	Sunbeam	20	524	17.3	22.18	2.36	4.20	2.42	1.78	0.36	2.44	1.05	0.10	0.15	1.20	—4.40	22	4.26	10.17	0.75	Excess of benzoate.
23723	Bishop's	27	476	25.7	14.13	2.19	2.36	1.30	1.06	0.34	1.00	1.02	0.10	0.14	—1.20	—2.64	22	1.09	7.61	1.73	Excess of benzoate.
23639	Eagle	10	746	6.1	10.40	2.42	3.41	2.53	0.88	0.62	1.13	1.20	0.10	0.07	3.00	3.08	21	0.00	*1.71	3.53	Glucose; cereal starch; excess of salt.
23633	Perfection	10	428	10.6	17.17	2.21	4.28	3.01	1.27	0.52	1.31	1.14	0.10	0.16	—0.80	—2.64	21	1.39	7.17	2.50	Excess of benzoate; small amount of starch.
23706	Table Talk	10	440	10.3	15.20	2.04	3.92	2.95	0.97	0.49	1.50	0.90	0.10	0.35	0.40	—1.91	21	1.75	4.39	3.15	Excess of benzoate.
23722	Home Made	10	421	10.8	23.43	2.69	6.89	5.17	1.72	0.45	1.38	1.08	0.10	0.14	4.00	—4.18	22	6.21	7.35	1.15	Excess of benzoate and salt.
23653	Blue Label	20	478	19.0	16.49	1.23	3.91	3.12	0.79	0.35	1.50	0.84	0.10	0.15	5.20	—1.10	21	4.44	*0.66	5.63	Excess of benzoate.
23699	Blue Bell	7	419	7.6	8.41	2.03	2.77	1.96	0.81	0.57	1.19	1.44	0.10	0.20	0.00	0.00	23	0.00	0.00	3.88	Excess of benzoate and salt; †artificial color and †saccharin.

* Glucose. † Stated on the label.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
				cts.																	
23655	Country Club	10	297	15.3	18.47	2.21	3.91	2.95	0.96	0.39	1.63	1.14	0.10	0.14	0.40	—3.52	21	2.97	8.41	1.16	Excess of benzoate.
23656	East Rock	10	806	5.6	8.47	2.43	3.01	2.29	0.72	0.66	1.25	1.50	0.10	0.25	—0.20	—0.44	21	0.18	1.24	2.13	Excess of benzoate and salt; † artificial color and † saccharin.
23641	Mascot	20	504	18.0	19.83	2.63	3.33	2.07	1.26	0.53	2.50	1.20	0.10	0.12	1.00	—3.73	21	3.58	8.44	1.45	Excess of benzoate; no place of manufacture.
23726	Jack Dalton, Jr.	10	313	14.5	12.97	2.45	1.77	0.95	0.82	0.43	1.00	0.93	0.10	0.22	2.00	—2.64	22	3.52	5.05	1.20	Excess of benzoate; no place of manufacture.
23687	Gt. Atl. & Pac. Tea Co.	18	497	16.4	23.56	2.48	4.24	3.01	1.23	0.50	2.94	1.38	0.10	0.18	0.40	—4.40	21	3.63	10.57	1.68	Excess of benzoate; no place of manufacture.
23728	Crescent	12	721	7.5	7.45	2.47	2.87	1.99	0.88	0.33	0.94	0.54	0.10	0.23	0.00	0.00	23	0.00	0.00	3.31	Excess of benzoate and salt; † starch, saccharin (?), no place of manufacture.
23640	Royal	25	493	23.0	22.37	2.73	3.24	2.10	1.14	0.46	1.88	1.02	0.10	0.16	6.00	—4.40	21	7.87	6.12	2.80	Excess of benzoate; cereal starch.
23721	Best Yet	10	481	9.4	7.56	1.62	3.03	1.84	1.19	0.49	0.94	1.02	0.10	0.21	0.00	0.00	22	0.00	0.00	3.10	Excess of benzoate and salt; † artificial color; † saccharin; no place of manufacture.
23712	Windsor	10	433	10.5	15.43	2.15	2.25	1.37	0.88	0.48	1.38	0.72	0.10	0.15	2.60	—2.42	22	3.81	4.02	3.49	Excess of benzoate; no place of manufacture.
23698	Red Berry	25	509	22.3	24.82	2.74	3.77	2.87	0.90	0.54	1.19	1.08	0.00	0.25	10.00	8.36	21	1.24	*5.01	13.07	Contains glucose and starch; benzoate not stated on label.
23648	LeRoy	10	379	12.0	16.57	1.71	4.48	3.73	0.75	0.48	1.63	1.14	0.10	0.13	....	...	..	...	....	...	Excess of benzoate and salt.

* Glucose. † Stated on the label.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Continued.*

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material.																Remarks.
					Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature.	Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	
				cts.																	
23704	Libby's	10	194	23.4	28.26	4.08	4.70	3.26	1.44	0.58	3.06	1.68	0.10	0.11	6.00	—2.64	21	6.53	6.52	6.87	Excess of benzoate.
23727	Monogram	25	491	23.1	18.56	2.28	3.62	2.15	1.47	0.39	2.13	1.14	0.10	0.16	1.40	—3.96	22	4.07	9.16	+0.84	Excess of benzoate; no place of manufacture.
23703	Spindle City	10	456	9.9	14.66	1.96	2.54	1.86	0.68	0.48	1.13	0.72	0.10	0.38	2.40	—3.30	21	4.31	6.25	+0.05	Excess of benzoate.
23654	Nail City	10	347	13.1	11.83	2.13	2.88	1.85	1.03	0.57	1.75	1.26	0.10	0.18	0.20	—0.88	21	0.82	2.03	3.78	Excess of benzoate.
23684	Old Virginia	25	483	23.5	17.21	1.77	3.69	2.60	1.09	0.38	2.38	0.93	0.10	0.17	1.80	—3.08	21	3.69	6.19	0.88	Excess of benzoate.
23649	Parker House	9	347	11.8	15.43	1.35	4.69	3.92	0.77	0.58	1.56	1.41	0.10	0.14	3.40	—0.88	23	3.28	0.00	5.32	Excess of benzoate and salt.
23651	None Such	10	449	10.1	13.92	1.82	2.58	1.63	0.95	0.48	1.75	0.84	0.10	0.12	3.60	—0.44	21	3.05	*0.54	5.52	Excess of benzoate; no place of manufacture.
23657	Mohican	11	369	13.5	12.99	2.60	3.12	2.44	0.68	0.55	1.25	1.11	0.10	0.14	3.40	1.10	23	1.75	*0.94	5.38	Excess of benzoate; glucose; no place of manufacture.
23688	Celebrated White Label (Orrell)	10	345	13.4	12.65	2.45	1.94	1.35	0.59	0.48	1.25	1.14	?	0.21	0.00	—2.20	21	1.66	5.43	1.89	Amount of benzoate not stated.
23711	20th Century	10	428	10.6	14.52	1.90	4.40	3.34	1.06	0.47	1.06	0.78	0.10	0.33	1.00	—1.51	22	1.91	3.03	3.65	Excess of benzoate and salt.
23782	Omega	10	386	11.8	24.74	2.28	4.59	3.00	1.59	0.32	2.38	1.14	0.10	0.14	2.40	—5.72	22	6.17	12.53	+1.25	Excess of benzoate.
23716	Winorr	20	466	19.5	21.02	2.12	3.73	2.33	1.40	0.42	1.44	1.14	0.10	0.13	0.00	—4.40	22	3.34	11.10	0.99	Excess of benzoate.
23683	Club House	10	454	10.0	19.28	2.38	5.09	3.98	1.11	0.63	1.56	1.29	0.10	0.32	0.60	—3.08	21	2.78	7.14	2.08	Excess of benzoate and salt.
23767	Celebrated White Label (Schoenberg)	10	350	13.0	13.40	2.46	2.42	1.72	0.70	0.55	1.13	0.72	?	0.23	0.80	—2.20	22	2.28	4.92	2.10	Amount of benzoate not stated.
23658	Long Is. Delight	5	223	10.2	8.33	1.89	2.92	1.99	0.93	0.46	1.56	1.41	0.10	0.19	0.00	0.00	21	0.00	0.00	3.39	Excess of benzoate and salt.
23689	Imperial Home Made	10	443	10.2	18.64	2.40	5.51	4.04	1.47	0.50	2.06	1.14	0.10	0.26	1.80	—2.20	21	3.03	4.03	3.51	Excess of benzoate and salt; no place of manufacture.

* Glucose.

TABLE XXIX.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCESS OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL—*Concluded*.

Station No.	Brand.	Price per bottle, cents.	Net weight of contents, grams.	Cost of Ketchup per lb.	Analysis of Original Material.													Sucrose.	Invert Sugar or Glucose (*).	Undetermined.	Remarks.
					Total Solids.	Insoluble Solids.	Ash.	Sodium Chloride, calculated from chlorine.	Sodium Chloride-free Ash.	Fiber.	Protein (Nx6.25).	Acetic Acid.	Sodium Benzoate. Claimed.	Sodium Benzoate. Found.	Polarization. Direct.	Polarization. After Inversion	Polarization. Temperature.				
				cts																	
23636	Richelieu	25	483	23.5	15.57	1.95	2.83	1.63	1.20	0.44	1.50	0.78	0.10	0.14	2.00	—3.52	21	4.18	7.14	+0.52	Excess of benzoate; no place of manufacture.
23635	Squire	10	429	10.6	12.82	2.14	2.46	1.48	0.98	0.47	1.38	1.02	0.10	0.13	2.00	—1.76	21	2.84	2.75	2.92	Excess of benzoate.
23643	Gold Leaf	25	599	18.9	14.49	1.79	3.66	2.59	1.07	0.48	0.94	1.02	0.10	0.30	0.40	—2.20	21	1.97	5.14	2.30	Excess of benzoate; starch; no place of manufacture; benzoate not stated on main label.
23637	High Grade	10	409	11.1	7.51	1.33	2.71	1.81	0.90	0.62	1.13	1.38	0.10	0.20	0.00	0.00	21	0.00	0.00	3.05	Excess of benzoate and salt; †artificial color; †saccharin; no place of manufacture.
23629	Our Own	10	429	10.6	10.97	2.41	2.39	1.66	0.73	0.51	1.00	0.90	0.10	0.32	0.00	—1.32	21	1.00	3.27	2.80	Excess of benzoate; no place of manufacture.
23634	Seaside	10	419	10.8	14.22	1.38	2.47	1.59	0.88	0.47	0.88	0.60	0.10	0.20	5.00	0.22	21	3.06	*1.68	5.66	Excess of benzoate; glucose; no place of manufacture.
23652	Van Camp's	15	510	13.3	20.10	3.32	3.78	2.56	1.22	0.51	2.50	1.44	0.10	0.24	—1.80	—3.74	21	1.48	10.73	1.10	Excess of benzoate.
23783	Pure Food	10	442	10.3	8.14	1.84	3.17	2.21	0.96	0.55	1.06	1.02	0.10	0.21	0.00	0.00	22	0.00	0.00	3.36	Excess of benzoate and salt; † artificial color; † saccharin; no place of manufacture.
23650	New England	10	413	11.0	16.42	2.96	3.97	2.92	1.05	0.66	1.63	1.08	0.10	0.30	1.40	—1.98	21	2.56	3.17	4.43	Excess of benzoate.
23709	Waldorf	10	336	13.5	23.48	2.22	4.43	3.37	1.06	0.50	1.75	1.08	0.10	0.13	3.00	—4.40	21	5.60	8.51	2.69	Excess of benzoate.
23642	Yellow Label	10	445	10.2	15.99	1.85	3.34	2.57	0.77	0.55	1.13	0.96	0.10	0.08	3.80	1.10	21	2.04	*1.01	7.92	No manufacturer given; no cork; ketchup in contact with metal top.
23645	No brand or manufacturer	10	414	11.0	15.63	2.21	4.64	3.88	0.76	0.41	1.44	0.96	0.10	0.25	0.00	—1.76	21	1.33	4.35	3.46	Excess of benzoate and salt; no place of manufacture.

* Glucose. † Stated on the label.

TABLE XXX.—KETCHUPS NOT CONTAINING SODIUM BENZOATE.

Station No.	Brand.	Water-free Basis.					Water-Sodium Chloride-free Basis.			
		Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Insoluble Solids.	Ash.	Fiber.	Protein (N x 6.25).
3696	Beech-Nut	8.91	12.97	4.48	2.11	8.44	9.74	4.90	2.30	9.25
3647	Campbell's	13.46	21.50	5.21	3.17	11.13	16.23	6.21	3.79	13.31
3646	Columbia	7.71	17.32	5.04	1.77	10.50	8.79	5.75	2.02	12.00
3686	Hazard's	10.22	23.64	4.83	2.19	9.00	12.59	5.95	2.70	11.06
3695	Heinz	6.43	12.25	2.86	1.29	6.56	7.10	3.16	1.42	7.25
3771	Manhattan Club	7.76	12.72	3.72	1.45	4.88	8.52	4.09	1.60	5.38
3644	Sunny Side	9.11	11.99	3.70	1.71	6.00	9.93	4.04	1.86	6.56

TABLE XXXI.—KETCHUPS CONTAINING SODIUM BENZOATE NOT IN EXCESS OF AMOUNT CLAIMED.

Station No.	Brand.	Water-free Basis.					Water-Sodium Chloride-free Basis.			
		Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Insoluble Solids.	Ash.	Fiber.	Protein (N x 6.25).
3631	Bowe	22.79	14.93	8.66	5.57	11.06	24.31	9.24	5.94	11.81
3710	Home	18.05	19.54	4.10	3.32	8.94	21.34	4.85	3.93	10.63
3718	Shiloh	17.24	18.55	3.93	3.93	8.63	20.19	4.60	4.60	10.13
3682	Cruikshank's	12.86	15.46	4.48	2.60	7.81	14.44	5.03	2.92	8.75
3632	Red Jacket	11.63	17.51	6.00	2.63	7.00	13.15	6.76	2.97	7.88
3702	Bon Ton	12.41	9.29	4.39	3.29	9.38	13.05	4.61	3.46	9.88
3713	Ohio Valley Pres. Co.	15.82	23.11	8.58	3.70	8.69	18.51	10.04	4.33	10.19
3714	Stohrer's	15.63	18.93	4.64	3.56	8.75	18.24	5.41	4.15	10.19
3705	Winner	9.07	17.81	5.00	2.28	9.25	10.41	5.69	2.62	10.63
3681	Pride of the Farm	22.41	18.49	5.41	4.23	13.63	25.78	6.22	4.87	15.69
3768	American Beauty	14.04	19.41	6.56	2.54	9.25	16.11	7.53	2.91	10.63
3685	Snider's	11.18	22.47	4.42	1.86	8.31	13.65	5.39	2.27	10.13
3628	Tomato Catsup (Standard)	17.24	29.58	6.72	4.54	13.06	22.35	8.71	5.88	16.94
3638	Pride of Connecticut	14.56	8.22	3.53	3.73	6.38	15.28	3.71	3.91	6.69
3630	Hoffman House	16.88	15.26	4.90	2.45	9.75	18.83	5.46	2.73	10.88

tables of analysis on the basis which most directly affects the legality of their sale in this state, that is, as to whether preservatives are present, and if so, whether the amount found corresponds to that stated on the label. Accordingly, three groups have been formed, those which contained no sodium benzoate, those which contained benzoate not in excess of the amount

TABLE XXXII.—KETCHUPS CONTAINING SODIUM BENZOATE IN EXCES OF AMOUNT CLAIMED, OR OTHERWISE ILLEGAL.

Station No.	Brand.	Water-free Basis.					Water-Sodium Chloride- Basis.			
		Insoluble Solids.	Ash.	Sodium Chloride-free Ash.	Fiber.	Protein (N x 6.25).	Insoluble Solids.	Ash.	Fiber.	Protein
23719	American	25.26	22.94	7.65	4.47	7.00	29.82	9.03	5.29	8
23724	Standard	33.01	13.05	5.27	1.79	5.44	35.79	5.72	1.95	5
23707	Anderson	28.20	36.45	7.57	6.05	12.88	39.65	10.64	8.51	18
23690	Home Made Long Island	17.56	29.82	5.18	2.80	9.50	23.30	6.87	3.72	12
23758	Lion	16.11	25.56	6.83	3.89	8.69	19.82	8.41	4.78	10
23717	Sunbeam	10.64	18.94	7.94	1.62	11.00	11.94	9.01	1.82	12
23723	Bishop's	15.50	16.70	7.50	2.41	7.06	17.07	8.26	2.65	7
23639	Eagle	23.27	32.79	8.46	5.96	10.81	30.75	11.18	7.88	14
23633	Perfection	12.87	24.93	7.40	3.03	7.63	15.61	8.97	3.67	9
23706	Table Talk	13.42	25.79	6.38	3.22	9.88	16.65	7.92	4.00	12
23722	Home Made	11.48	29.41	7.34	1.92	5.88	14.73	9.42	2.46	7
23653	Blue Label	7.46	23.71	4.79	2.12	9.13	9.20	5.91	2.61	11
23699	Blue Bell	24.14	32.94	9.63	6.78	14.13	31.47	12.56	8.84	18
23655	Country Club	11.97	21.17	5.20	2.11	8.81	14.24	6.19	2.51	10
23656	East Rock	28.69	35.54	8.50	7.79	14.75	39.32	11.65	10.68	20
23641	Mascot	13.26	16.79	6.35	2.67	12.63	14.81	7.09	2.98	14
23726	Jack Dalton, Jr.	18.89	13.65	6.32	3.32	7.69	20.38	6.82	3.58	8
23687	Gt. Atl. & Pac. Tea Co.	10.53	18.00	5.22	2.12	12.50	12.07	5.99	2.43	14
23728	Crescent	33.15	38.52	11.81	4.43	12.56	45.24	16.12	6.04	17.
23640	Royal	12.20	14.48	5.09	2.06	8.38	13.47	5.62	2.27	9.
23721	Best Yet	21.43	40.08	15.74	6.48	12.38	28.32	20.80	8.57	16.
23712	Windsor	13.93	14.58	5.70	3.11	8.94	15.29	6.26	3.41	9
23698	Red Berry	11.04	15.19	3.63	2.17	4.81	12.48	4.10	2.46	5.
23648	LeRoy	10.32	27.04	4.53	2.90	9.81	13.32	5.85	3.74	12.
23704	Libby's	14.44	16.63	5.10	2.05	10.81	16.32	5.76	2.32	12.
23727	Monogram	12.28	19.50	7.92	2.10	11.44	13.89	8.96	2.38	12.
23703	Spindle City	13.37	17.33	4.64	3.27	7.69	15.31	5.31	3.75	8.
23654	Nail City	18.00	24.34	8.71	4.82	14.81	21.34	10.32	5.71	17.
23684	Old Virginia	10.28	21.44	6.33	2.21	13.81	12.11	7.46	2.60	16.
23649	Parker House	8.75	30.40	4.99	3.76	10.06	11.73	6.69	5.04	13.
23651	None Such	13.07	18.53	6.82	3.45	12.50	14.81	7.72	3.91	14
23657	Mohican	20.00	24.02	5.23	4.25	9.63	24.64	6.44	5.21	11.
23688	Cel. White Label (Orrell)	19.37	15.34	4.66	3.79	9.88	21.68	5.22	4.24	11.
23711	20th Century	13.09	30.30	7.34	3.24	7.31	16.99	9.48	4.20	9.
23782	Omega	9.22	18.55	6.43	1.29	9.63	10.49	7.31	1.47	10.
23716	Winorr	10.09	17.75	6.66	2.00	6.81	11.34	7.49	2.25	7.
23683	Club House	12.34	26.40	5.76	3.22	8.13	15.56	6.49	3.63	9.
23767	Cel. White Label (Schoenberg)	18.36	18.06	5.22	4.10	8.38	21.06	5.99	4.71	9.
23658	Long Island Delight	22.69	35.05	11.16	5.52	18.75	29.81	14.66	7.25	24.
23689	Imperial Home Made	12.88	29.56	7.89	2.68	11.06	16.44	10.07	3.42	14.
23636	Richelieu	12.52	18.18	7.71	2.83	9.63	13.99	8.61	3.16	10.
23635	Squire	16.69	19.19	7.64	3.67	10.75	18.87	8.64	4.14	12.
23643	Gold Leaf	12.41	25.26	7.38	3.31	6.44	15.04	9.00	4.03	7
23637	High Grade	17.71	36.09	11.98	8.26	15.00	23.33	15.79	10.88	19
23629	Our Own	21.97	21.79	6.65	4.65	9.13	25.89	7.84	5.48	10.
23634	Seaside	9.70	17.37	6.19	3.30	6.13	10.93	6.97	3.72	6.
23652	Van Camp's	16.52	18.81	6.07	2.54	12.44	18.93	6.95	2.91	14.
23783	Pure Food	22.61	38.94	11.79	6.76	13.06	32.72	16.19	9.27	17.
23650	New England	18.03	24.18	6.40	4.02	9.88	21.93	7.78	4.89	12.
23709	Waldorf	9.45	18.87	4.51	2.13	7.44	11.04	5.27	2.49	8.
23642	Yellow Label	11.57	20.89	4.82	3.44	7.06	13.79	5.74	4.10	8.
23645	No Brand or Mfr.	14.14	29.69	4.86	2.62	9.19	18.81	6.47	3.49	12.

claimed, and those which contained benzoate in excess of the claimed amount or were otherwise illegal. In our first consideration of the results, the amount of preservative found is the basis of our judgment. It must be understood, however, that this classification is an arbitrary one and only in a general way reflects quality. Good ketchups, aside from the matter of preservative, are found in all three classes, and some of the ketchups included in the first class, from the standpoint of quality, are no better than some classed in the other two groups.

Tables XXVII to XXIX give the analysis of the original material, together with data as to price and amount sold; tables XXX to XXXII give the results calculated to the water-free, and water-sodium-chloride-free bases.

Guarantees as to Benzoate.

Eight samples were sold as containing no benzoate, one was claimed to contain 0.03 per cent., sixty-two 0.10 per cent., and three indicated benzoate on the label without stating the quantity.

Only one sample whose label was silent on the subject was found to contain benzoate; sample **23698**, *LeRoy Packing Co.'s Red Berry Brand,* contained 0.25 per cent.

The sample claimed to contain 0.03 actually contained 0.10 per cent.

Of the sixty-two samples claiming 0.10 per cent., forty-five exceeded that amount, ranging from 0.11 to 0.38 per cent.

In the three samples in which the quantity was not stated on the label, 0.13, 0.21 and 0.23 per cent. was found.

Our findings as to benzoate may be summarized as follows:

Contained no Benzoate	7	brands
" from .04 to .10 Benzoate	18	"
" " .11 to .20 "	30	"
" " .21 to .30 "	14	"
" over .30 Benzoate	5	"

It is clear from the above that the catch-phrase "Preserved with one-tenth of one per cent. of sodium benzoate" has little real significance as to the actual amount of preservative present. Of

sixty-three samples claiming a definite amount of benzoate, forty-six, or 73 per cent., exceeded that amount, five samples containing over three times the amount claimed.

It is of interest to note the relative composition of the benzoated and nonbenzoated samples. This is shown in Table XXXIII.

TABLE XXXIII.—AVERAGE ANALYSES.

	Containing no benzoate.	Containing benzoate.	All Samples.
In original material:			
Water	76.91	84.20	83.78
Insoluble solids	2.00	2.25	2.32
Ash	3.48	3.38	3.39
Ash-NaCl	0.94	0.98	0.98
Fiber	0.42	0.50	0.49
Protein	1.76	1.50	1.53
Acetic acid	1.35	1.08	1.11
Water-free basis:			
Insoluble solids	9.09	15.90	15.26
Ash	16.06	22.53	21.91
Ash-NaCl	4.26	6.60	6.38
Fiber	1.96	3.49	3.35
Protein	8.07	9.69	9.53
Water-NaCl-free basis:			
Insoluble solids	10.41	19.24	18.40
Ash	4.87	7.97	7.68
Fiber	2.24	4.25	4.06
Protein	9.26	11.63	11.41

While in the original substance there are no striking differences in the averages, except the amount of water found, too much dependence must not be placed on these averages, for in the benzoated samples in particular they represent the means of widely divergent extremes. For instance, in these samples the water ranges from 71.74 to 92.73 per cent., insoluble solids from 1.23 to 6.07, ash from 1.61 to 6.89, sodium chloride from 0.71 to 5.17, fiber from 0.32 to 0.77, protein from 0.81 to 3.06, and acidity from 0.54 to 1.68. The nonbenzoated samples show much more uniform composition, but even here there are wide variations in water and acidity.

The following summary shows the extremes found in the various ingredients of the whole seventy-four samples, original material.

Total solids	7.27 to 32.49
Insoluble solids	1.23 to 6.07
Ash	1.61 to 6.89
Sodium chloride	0.71 to 5.17
Fiber	0.32 to 0.77
Protein	0.81 to 3.06
Acetic Acid	0.54 to 1.98
Sodium Benzoate	0.00 to 0.38

Acidity.

This determination can be best considered on the basis of original substance. It ranges from 0.54 to 1.98 per cent. acetic acid. The non-benzoated samples ranged from 0.85 to 1.98, the benzoated from 0.54 to 1.68 per cent. It has been urged by those who favor the use of benzoate in ketchup that the non-users secure their preservative effect by excessive amounts of acid, either in the form of vinegar or acetic acid extracts of the spices. At first glance our analyses would seem to lend some support to this contention, for two of the non-benzoated samples contain the high acidities of 1.83 and 1.98, 0.15 and 0.30 per cent. higher than the highest benzoated ketchups. It seems unfair, however, to consider acidity independent of the other ingredients of the ketchup. For instance, a ketchup might show a low acidity and yet be so low in solids that a very large quantity would have to be used to secure the desired condimental effect, while, on the other hand, a ketchup high in acidity might be so high in solids that only a small quantity would be needed to secure the same effect, and the acidity of the actual amount of ketchup used would be lower than in the low-solids ketchup. An examination of our tables shows that this statement is supported by the facts. The ratio of acidity to solids ranges from 12.7 to 24.8 in the non-benzoated samples with an average of 17.1, and in the benzoated samples from 5.4 to 29.8 with an average of 14.7. The two non-benzoated samples with high acidities show ratios of 12.7 and 16.4. The following table shows the variations in these ratios in the two classes of samples:

Acidity to Solids. 1 :	Non-benzoated.	Benzoated.
Over 25	–	1
19–25	2	18
12–19	5	28
9–12	–	14
5– 8	–	6
	7	67

In other words, twenty of the benzoated samples show a lower ratio of acidity to solids than the lowest of the non-benzoated samples.

Total Solids.

The solids range from 7.27 to 32.49, with an average of 16.22 per cent., illustrating the great variability of this material. Six samples contain over 24 per cent., nine from 20 to 24 per cent., thirty-one from 15 to 20 per cent., twenty from 10 to 15 per cent., and eight under 10 per cent. As will be shown later, the amount of solids considered by itself is not a safe criterion in judging the quality of a ketchup, for the solids may consist largely of added salt, sugar, glucose or cereal, and may be in very small part only true tomato solids. The eight samples showing the lowest solids were sold at what would appear to be a low price, from 5 to 12 cents for from 223 to 806 grams of ketchup. The average cost of the ketchup in these samples was 9.1 cents per lb., while in the six samples showing the highest solids the average cost was 17.3 cents per lb., that is, over three times the condiment (for water has no condimental value) was obtained in these for not quite double the price. These low-priced ketchups were, therefore, far from an economical purchase, leaving aside entirely the questions of quality and the presence of a chemical preservative.

The ratio of insoluble to total solids is of considerable value in judging a ketchup from chemical analysis, and will be discussed in a later section.

Salt.

Great variations in the content of salt are observed. The amounts of salt found in the ketchups ranged from 0.71 to 5.17 per cent., or from 4.69 to 28.88 per cent., water-free basis. The following tabulation shows the variations in salt content:

Per Cent. Salt in Solids.	No. of Samples.
Under 5	2
5–10	11
10–15	26
15–20	17
20–25	13
Over 25	5

The five samples showing over 25 per cent. of salt in the dry matter are interesting. Four of these are among the lowest in solids of all the samples examined, yet over one-fourth of this low solids consists of salt.

Brand.	Total Solids	Per Cent. of Salt in Solids.
Parker House	15.43	25.41
Crescent	7.45	26.71
East Rock	8.47	27.04
Pure Food	8.14	27.15
Anderson	7.27	28.88

Water-Sodium-Chloride-Free Basis.

A consideration of the samples on a water-free basis affords a more satisfactory basis of comparison, but even here the variable quantities of common salt used introduce a disturbing factor. For this reason all of the results have been further calculated to a water-sodium-chloride-free basis. Inasmuch as the quantity of spice used in the ketchup is relatively small to that of the tomatoes, the solids obtained by this method of calculation in a pure tomato ketchup should consist almost entirely of tomato solids and sugar. As the sugar contains no ash, fiber, protein or insoluble solids, the figures obtained for these ingredients by this calculation can be fairly attributed to the tomatoes, provided of course we are dealing with a pure tomato ketchup.

Insoluble Solids.

The insoluble solids in the original material range from 1.23 to 6.07; average, 2.32 per cent. They make up from 6.43 to 33.15 per cent. of the dry matter, and from 7.10 to 45.24 per cent. of the salt-free solids. It has already been shown that a very large proportion of the tomato pulp solids is soluble in water, while the solids of tomato skins and seeds have a much lower solubility. A high proportion of insoluble matter in a

ketchup, therefore, should suggest the use of skins or seeds, or the addition of some insoluble matter like starch. In one of the samples, 23724, the use of wheat flour was declared on the label, and here we find 6.07 per cent. of insoluble solids, making up 36 per cent. of the salt-free solids. Likewise in No. 23728, where cereals were declared on the label, we find over 45 per cent. of insoluble solids. In six samples the ratio of insoluble to total solids was over 10, in nineteen from 7 to 10, in thirty-seven from 4 to 7 and in twelve less than 4. This low ratio shown by these twelve samples would seem to indicate that tomato pulp was not the only source of their solids. In eight samples we have a declaration on the label of the use of material other than tomato pulp; in one tomato trimmings were used, in two cereals and in five apples. The ratio and actual percentage of insoluble solids in these samples is as follows:

Foreign substance declared.	Per Cent. Salt-free Solids Insoluble.	Ratio of Insoluble to Total—Salt-free Solids.
Tomato Trimmings	19.82	1 : 5.0
Cereal	35.79	1 : 2.8
"	45.24	1 : 2.2
Apples	23.33	1 : 4.3
"	28.32	1 : 3.5
"	31.47	1 : 3.2
"	32.72	1 : 3.2
"	39.32	1 : 2.5
Average 6 high-grade ketchups	8.88	1 : 11.4

Ash.

The ash ranges from 1.61 to 6.89; average, 3.39 per cent. in the original substance, or from 8.22 to 40.08 per cent. on the water-free basis. The amount of ash is affected, of course, by the varying content of sodium chloride, but the variations are by no means solely due to the salt present. In the original substance the salt-free ash ranges from 0.55 to 1.78 per cent., in the water-free substance from 2.86 to 15.74, and in the water-salt-free material from 3.16 to 20.80.

In our analysis of pure tomato pulp we found that the ash made up about 11 per cent. of the water-free substance. Because of the use of sugar, which contains no ash, and other materials which are relatively low in ash compared with tomato pulp, the salt-free ash of ketchup should be much lower than that of the original pulp. While it is difficult to set a maximum limit for

salt-free ash in ketchup, the ketchups themselves show in our tables of analysis what should be expected in a high-grade ketchup. For instance, we find that the salt-free ash in the water-salt-free material is under 5 per cent. in nine samples, from 5 to 8 in forty, from 8 to 10 in thirteen, and over 10 in twelve samples. We find that the twenty-seven samples containing about 6 per cent. or less of salt-free ash include what are recognized as the highest grade brands on the market, that is, high grade from the standpoint of the quality of materials used, and entirely independent of whether or not benzoate is present. It is a striking fact, however, that the non-benzoated samples contain only from 3.16 to 6.21 per cent., while the benzoated ketchups contain from 3.71 to 20.80, only twenty-one of sixty-seven samples of the latter class containing less than 6 per cent. It would seem, therefore, adopting the best trade practice as a basis of judgment, that samples containing much over 6 per cent. of salt-free ash in the dry salt-free material must be considered with suspicion, and that those containing over 10 per cent. are not pure ketchups. That is, from this standpoint alone, twelve of our samples must be considered as more than suspicious. These twelve samples in the dry salt-free material contain from 10.04 to 20.80 per cent. salt-free ash, from 16.44 to 45.24 per cent. insoluble solids, from 4.33 to 10.88 per cent. crude fiber, and from 14.13 to 24.63 per cent. protein, all of which data indicates their inferiority.

Crude Fiber.

The crude fiber ranges from 0.32 to 0.77 per cent. in the original substance; average, 0.49 per cent.; and from 1.29 to 8.26 in the dry matter, and from 1.42 to 10.88 per cent. in the water-salt-free material. A high fiber content is characteristic of tomato seeds and skins, especially the latter. In the dry salt-free material seventeen of the samples contain less than 2.50 per cent. of fiber, twenty-nine from 2.50 to 4 per cent., sixteen from 4 to 5.50 per cent., and twelve over 5.50 per cent. The high percentages of fiber are as a rule associated with high insoluble solids and high salt-free ash.

Protein.

The protein ranges from 0.81 to 3.06 per cent., average, 1.53, in the original substauce, and from 4.88 to 18.75 per cent. in

the dry matter, and from 5.38 to 24.63 in the water-salt-free material. The most marked characteristic of tomato seeds is their high protein content, about 31 per cent. An abnormally high protein in ketchup would suggest, therefore, an imperfect separation or the direct addition of tomato seeds. In the dry salt-free matter eighteen samples contain less than 9 per cent. of protein, twenty-seven from 9 to 12 per cent., nineteen from 12 to 15 per cent. and ten over 15 per cent. The samples containing the greatest amount of protein also as a rule are high in salt-free ash, insoluble solids and crude fiber.

Sugar, Glucose and Starch.

All the samples were polarized before and after inversion. The presence of acetic acid renders the exact determination of sucrose and invert sugar somewhat difficult, and the percentages given in the tables are not claimed to be absolute. The amounts found were very variable, ranging from none at all to as much as 24 per cent. total sugars. It must be remembered, however, that the tomato itself contains much sugar, according to König over 50 per cent. of the dry matter, and the presence of sugar in ketchup is, therefore, to be expected, and its absence would indicate that little if any of the tomato juice and pulp had been used. It is the common practice to employ sugar in the manufacture of ketchup, the amount used resting solely with the manufacturer and the taste of the consumer. The standard definition permits the use of sugar, but if glucose is used as the sweetening agent, its presence should be stated on the label. Only two brands declared glucose on the label and these, the product of the same manufacturer, contained 13.75 and 13.36 per cent., making up nearly 50 per cent. of the solids of the ketchup. Twelve other samples contained from 0.39 to 5.01 per cent. None of the glucose-containing samples has been classed as illegal for that reason alone, although glucose must be considered as a substitute for sugar, and its presence should be declared on the label.

Starch was not determined quantitatively, but all the samples were examined under the microscope for starch. Pepper or paprika starch was observed in many of the samples, and their presence is entirely proper. The use of cereals, however, is contrary to the standard for pure ketchup; they add nothing to the

condimental value and serve simply as make-weight or as a means of giving body to an otherwise thin ketchup. Nine samples contained cereal starch, and in only two of these was it declared on the label. The column marked "undetermined" in our tables chiefly represents starch, and in certain samples this is shown to be inordinately high. For instance, No. 23724 shows 10.15 and No. 23698, 13.07 per cent.

The general use of sugar, and the frequent addition of glucose or starch, prevents the percentage of total solids, taken by itself, from being a safe guide as to the quality of a ketchup.

Saccharin.

Saccharin has no place in ketchup, or in any food product intended for normal consumers. The purpose of its use is solely to lower the cost of manufacture. In five samples its presence was declared on the label, and these brands are among the lowest grades of ketchup included in our examination. Two other samples gave zero polariscope reading both before and after inversion, and this would suggest the presence of saccharin, although the pungency of the spices used prevented its certain identification.

Artificial Color.

Nine samples contained artificial color, in seven of which color was declared on the label. Nos. 23719 and 23707 contained color without any declaration to that effect.

Suggested Limits of Composition.

It was hoped when this investigation was begun that there would be found certain definite ratios between the various ingredients of the ketchups that would possess diagnostic value. A very careful study of our tables of analysis has shown that no safe conclusion as to quality can be drawn from these particular ratios, except that of insoluble to total salt-free solids. Calculating the results to the water-salt-free basis, it is seen that there are very striking differences in this ratio between high- and low-grade ketchups. It ranges from 2.2 to 14.1 in the seventy-four samples, or expressing the same fact in another way, the insoluble solids make up from 7.10 to 45.24 per cent. of the salt-free solids. We have formed two groups of samples, the first consisting of

sixteen brands of generally recognized high-grade ketchups, second consisting of thirteen brands, which either cond themselves by the information given on their labels, or are sh to be of low grade by our analysis. The following table sh the maxima, minima and averages of the various ingredi found in the two groups:

	High-Grade (16 Samples). Max.	Min.	Ave.	Low-Grade (13 Samples). Max.	Min.
In Original Substance:					
Total solids	32.49	14.22	20.56	16.42	7.27
Sodium benzoate	0.20	0.00	0.08	0.30	0.07
NaCl in total solids..	18.92	4.90	12.46	28.88	15.63
In Salt-free Dry Substance:					
Insoluble solids	14.24	7.10	11.22	45.24	21.34
Ash	6.97	3.16	5.38	16.19	7.78
Fiber	4.10	1.42	2.56	10.88	4.89
Protein	12.00	5.38	9.06	24.63	12.00
Ratio insol. to total solids (1:–)	14.1	7.0	8.9	4.7	2.2

In the samples which we have classed as high grade the m mum insoluble solids is 14.24, ash 6.97, fiber 4.10, protein 1 and the lowest ratio of insoluble to total solids is 1 : 7; in samples classed as low grade these maxima are exceeded in e case, and the highest ratio of insoluble to total solids is 1 : 4.7 is interesting to note also that all but one of the seven sam found to contain no benzoate are included in the high-grade cl the low-grade brands on the average contained more than t as much benzoate as the high-grade. Likewise the proportio salt to total solids is on the average nearly twice as high in low-grade brands. By examining the tables it will be found the forty-five other brands not included in the above group possess some of the characteristics of one or the other gro but that none shows all the characteristics of either.

We would suggest as a tentative standard that pure tor ketchup should contain in the salt-free dry substance not n than 15 per cent. insoluble solids, not more than 7 per cent. not more than 4 per cent. fiber and not more than 12 per c protein; the ratio of insoluble to total salt-free solids should be less than 1 to 7.

The Cost of Ketchup.

The contents of all the bottles were weighed, and from this data the cost per pound of ketchup calculated, which ranged from 5.6 to 25.7 cents. When the content of total solids is considered, it is evident that the cheapness of most of the low-priced ketchups is more apparent than real.

Methods of Analysis.

The methods employed were the usual ones for this class of materials. Benzoic acid was determined by the method suggested by P. B. Dunbar, associate referee on preservatives of the A. O. A. C. in 1909, as follows:

Weigh 150 gms. of ketchup in a 500 c.c. flask, add 15 gms. pulverized sodium chloride and shake thoroughly. Make slightly alkaline with 10 per cent. sodium hydroxide solution, and fill to the mark with saturated sodium chloride solution. Shake several times and allow to stand over night. Filter through a folded filter and transfer 150 c.c. to a separatory funnel. Neutralize the filtrate to litmus paper with sulphuric acid (1 to 5), about 1 c.c., and add 5 c.c. excess of this acid. Extract with 50, 30, 25 and 25 c.c. portions of chloroform, breaking up any emulsion by twirling the separator and breaking up the bubbles with a glass rod. Evaporate the combined chloroform extracts to dryness at room temperature, using reduced pressure. Dissolve the residue in 25 c.c. neutral alcohol, dilute with 10 c.c. water and titrate with tenth-normal sodium hydroxide, using 4 drops of strong phenolphthalein as indicator. One c.c. of tenth-normal alkali equals 0.0144 gms. sodium benzoate.

This method gave excellent results. In a non-benzoated ketchup, to which a known quantity of sodium benzoate was added, the theoretical amount was recovered. Duplicate determinations of sodium benzoate were made in every sample by two different analysts. In the seventy-four samples only six of the duplicate determinations varied over 0.01 per cent. with 0.032 as the maximum variation, notwithstanding the fact that, because of the limited amount of material, many of the duplicates were made in different amounts of material, 150 and 75 gms. A blank determination in a pure ketchup gave 0.01 per cent., which has been deducted in every case.

MISCELLANEOUS FOODS.

Gluten Preparations.

Six gluten preparations were analyzed. The first five were from the stock of John Gilbert & Son, New Haven; the last, a local product sent in by Dr. W. R. Miller, Southington.

24109. Pates aux Oeufs Macaroni. Brusson Jeune. Price, 45 cents for 220 gms.

24110. Vermicelle au Gluten Extrait des meilleurs blés de Russie. Brusson Jeune, Villemur. Price, 45 cents for 449 gms.

24111. Pates aux Oeufs Nouillettes. Brusson Jeune. Price, 30 cents for 231 gms.

24112. *Gluten Semolina. Semoule du Gluten.* Brusson Jeune, Villemur. "Indispensable to diabetic constitutions and to delicate persons affected by illeness (sic) or excess." Price, 30 cents for 209 gms.

24113. Gluten Bread. Brusson Jeune (in bulk). Price, 10 cents per loaf of 30 gms.

23398. Diabetic Bread.

	24109	24110	24111	24112	24113	23398
Water	8.57	7.96	8.67	9.65	7.47	29.60
Ash	0.68	0.80	0.65	0.70	1.08	1.45
Protein ($N \times 6.25$)	*13.94*	*18.44*	*14.38*	*17.19*	*32.06*	*21.24*
Fiber	tr.	tr.	tr.	0.28	0.23	.....
Extract	76.38	72.37	75.77	71.72	57.07	*45.11
Fat	0.43	0.43	0.53	0.46	1.79	2.60
Starch	69.21	65.79	68.90	64.89	49.77	33.66

None of these samples is particularly to be recommended to diabetics or to those requiring a diet low in starch. The gluten bread and diabetic bread are by far the most satisfactory preparations, but even in these the starch is much too high. No. 24112, which is especially recommended for diabetics, contains nearly 65 per cent. of starch. When the true nature of the first five samples was reported to Messrs. John Gilbert & Son, they immediately reshipped all of their remaining stock back to the New York importers.

Cerena.

22300. Cerena Cereal Fruit and Vegetable Food. The Cerena Milling Co., Chicago. "A Food Remedy for Constipation and Stomach Disorders." Price, 25 cents for 431 gms. It contained:

Water	7.19
Ash	4.88
Protein ($N \times 6.25$)	27.81
Fiber	2.40
Extract	46.35
Ether Extract	11.37

* Includes fiber.

Starch	25.14
Soluble in Water	25.40
Water-soluble Protein	5.63
Total Phosphoric Acid	2.32
Phytin Phosphoric Acid	0.67
Refractive Index of Ether Extract @ 26°	1.4750

According to the claims of the manufacturer, the "cereal, fruit and vegetable" nature of the food rests on the use of wheat, olive oil and cottonseed meal, a rather loose interpretation. The special claim for this remedy for constipation is based on the presence of phytin. We find 0.67 per cent. of phosphoric acid in this form. No mineral laxatives were detected, nor was there any evidence of the use of vegetable purgatives, like senna, cascara, etc.

Olive Oil.

One sample taken from the stock of a grocer was found not to be adulterated.

24114. Olive Tree Blossom Authentical Olive Oil, bottled at Nice. Benoit Mayrargue Fils et Cie. Sold by Conrad Weiss, New Haven. Price, 45 cents per bottle.

It showed a specific gravity at 15.5° C. of 0.916, an index of refraction at the same temperature of 1.4706, and contained no cottonseed, sesame or peanut oils.

II. DRUG PRODUCTS.

ALCOHOL.

"A liquid composed of about 92.3 per cent. by weight, or about 94.9 per cent. by volume, of absolute ethyl alcohol." *U. S. P.*

In addition to the U. S. P. tests, the following methods were used:

Methods of Analysis.

Acidity was determined by titrating 10 c.c. of alcohol with fiftieth-normal potassium hydroxide solution, using phenolphthalein as the indicator.

To 10 c.c. of alcohol, ten drops of aniline oil and two or three drops of hydrochloric acid were added; in the presence of furfurol a more or less pinkish-red color is produced.*

* Kranch: Testing of Chemical Reagents for Purity, p. 14.

Windisch's test for aldehyde, etc.,* was used as follows:—10 c.c. of alcohol are put into a small test tube, and 0.5 c.c. of water and 1 c.c of a freshly prepared 10 per cent. aqueous solution of meta-phenylene-diamine hydrochloride are added. After one hour's standing there should be scarcely any coloration. In the presence of aldehydes a yellow to yellowish-red color immediately appears, followed by a fine greenish fluorescence which slowly darkens. In our experience with tests of absolute alcohol to which small quantities of formaldehyde had been added, the color of the solution was less indicative of the presence of aldehyde than the fluorescence.

The Swiss test for fusel oil† was used as follows:—10 c.c. alcohol were mixed with 30 c.c. of water and the odor and color at once noted.

The U. S. P. standard for alcohol may be stated briefly as follows:—A liquid containing about 94.9 per cent. by volume of absolute ethyl alcohol, of specific gravity 0.816 at 15.6° C., colorless, neutral to litmus, leaving no color or weighable residue on evaporation, free of more than traces of fusel oil, furfurol, aldehyde and oak tannin and other organic impurities. In other words, it requires alcohol to be practically a mixture of chemically pure absolute alcohol and distilled water. The experience gained from our examination of the seventy-one samples here reported leads us to conclude that this standard of excellence is almost unattainable. In fact, not one of our samples satisfies this standard *exactly in every particular*. It is well known that on long standing even pure absolute alcohol shows a yellow color, due to the formation of aldehyde by oxidation with the air. A slight color is often imparted to alcohol by the barrels in which it is stored, and such an alcohol would show a color when tested with caustic potash. It does not seem fair, therefore, to condemn an alcohol as impure which contains only traces of aldehydes and other impurities. It has been stated that chemically pure absolute alcohol is an impossible product, and we are strongly inclined to agree with this statement.

The details of our seventy-one analyses are given in Table XXXIV.

Specific Gravity and Alcohol. The specific gravity ranged from 0.8166 to 0.8486, with an average of 0.8221, naturally reflecting quite accurately the percentage of alcohol, which with the exception of one sample, ranged from 94.87 to 91.81 per cent.

* Krauch, p 12.

† Krauch, p. 11.

Station Number.	Price per 8 ounces.	Spec. gravity at 15.6° C.	Alcohol by volume.	Solids in 50 cc. of alcohol, and color of solids.	Acidity of 50 cc. (cc. N-50 KOH)	Furfurol. (aniline HCl test) Color.	Fusel oil. Krauch test for odor.	Tests for Aldehyde, etc. Caustic potash. Color.	Silver nitrate. Color.	Meta-phenylene-diamine hydrochloride. Color.	‡ Remarks.
	cts.			mgms.							
23241	25	.8166	94.87	1.7 v. s. b	1.35	none	none	none	f. brown	none	Passed
23292	30	.8169	94.79	1.6 v. s. b.	1.00	tr. pink	slight	none	none	f. brown, f. fluor.	Slight fusel oil
23269	30	.8170	94.76	2.0 s. b.	0.85	none	none	faint	f. brown	f. brown, no fluor.	Passed
23049	30	.8174	94.66	1.8 v. s. b.	1.60	none	none	faint	very faint	f. brown, f. fluor.	"
23098	25	.8178	94.56	2.7 b.	1.90	pink	none	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23057	25	.8184	94.41	1.8 s. b.	0.90	none	slight	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23131	30	.8186	94.36	2.0 s. b.	2.50	orange	none	very pr.	f. brown	dark orange, no fluor.	Excess acid, aldehyde
23156	25	.8186	94.36	2.2 v. s. b.	4.15	tr. pink	none	none	none	pr. orange, no fluor.	Excess solids, acid, aldehyde
23109	30	.8187	94.33	1.3 v. s. b.	1.00	tr. pink	slight	none	f. brown	f. yellow, f. fluor.	Slight fusel oil
23097	50	.8187	94.33	1.7 s. o. r.	2.45	pink	slight	faint	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23007	30	.8187	94.33	3.8 b.	0.75	pink	none	faint	pr. brown	none	Excess solids, aldehyde
22301	25	.8188	94.31	0.7 s. y.	1.50	pink	strong	faint	none	pr. yellow, fluor.	Excess fusel oil, aldehyde
23178	30	.8188	94.31	2.4 v. s.	0.85	none	slight	none	pr. brown	none	Excess solids, fusel oil, aldehyde
23058	25	.8189	94.28	1.6 v. s. y.	1.40	tr. pink	none	faint	f. brown	none	Passed
23010	30	.8189	94.28	3.2 y.	3.50	orange	none	very pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23325	25	.8190	94.26	6.0 s. y.	2.15	pink	none	pr.	v. pr. brown	v. pr. brown, uo fluor.	" " " "
23195	30	.8191	94.23	3.2 s. y.	1.75	pink	slight	faint	pr. brown	pr. brown, f. fluor.	Excess solids, acid, fusel oil, aldehyde
23096	30	.8193	94.18	2.7 s. y.	2.10	pink	none	faint	v. pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23050	30	.8195	94.13	2.0 v. s. b.	1.70	tr. pink	none	faint	f. opal	f. brown, f. fluor.	Passed
23279	25	.8195	94.13	1.6 v. s. o. r.	1.90	tr. pink	none	v. faint	f. brown	f. brown, no fluor.	Excess acid
23056	25	.8197	94.08	1.9 s. b.	1.10	none	slight	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23120	30	.8199	94.03	1.8 s. b.	1.50	tr. pink	none	faint	pr. brown	pr. brown, no fluor.	Excess aldehyde
23197	25	.8200	94.00	2.5 s. o. r.	1.10	pink	slight	v. faint	pr. brown	pr. yellow, pr. fluor.	Excess solids, fusel oil, aldehyde
23242	25	.8200	94.00	2.5 s. b.	2.00	tr. pink	none	none	f. brown	f. brown, no fluor.	Excess solids, acid
23055	25	.8202	93.95	9.0 s. b.	10.85	none	slight, opal.	faint	pr. brown	v. pr. brown, v. pr. fluor.	Excess solids, acid, fusel oil, aldehyde
22304a	30	.8205	93.87	1.1 n.	0.75	none	slight, opal.	none	f. brown	pr. yellow, pr. fluor.	Excess fusel oil, aldehyde
23221	30	.8209	93.77	4.1 s. y.	3.00	pink	none	pr.	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23154	25	.8209	93.77	2.2 v. s. y.	2.00	tr. pink	slight	none	f. brown	none	Excess solids, acid, fusel oil
23067	30	.8209	93.77	1.2 v. s. y.	1.20	pink	none	none	f. brown	none	Excess furfurol
23118	30	.8211	93.72	5.2 v. y. b.	3.25	brown	none	very pr.	very pr.	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23215	30	.8211	93.72	3.5 s. y.	3.00	pink	slight	pr.	pr. brown	pr. yellow, f. fluor	Excess solids, acid, fusel oil, aldehyde
23066	30	.8215	93.62	3.5 s. b.	1.25	pink	none	faint	pr. brown	none	Excess solids, aldehyde
23263	30	.8216	93.59	2.5 v. s. b.	1.25	tr. pink	slight	none	f. brown	f. yellow, f. fluor.	Excess solids, fusel oil
23011	25	.8217	93.57	1.6 r. o.	2.35	pink	slight	pr.	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23158	25	.8217	93.57	3.4 v. s. y.	0.90	none	none	none	f. brown	f. brown, no fluor.	Excess solids
23052	25	.8218	93.54	4.2 v. y.	1.15	brown	none	pr.	v. pr. brown	pr. brown, no fluor.	Excess solids, aldehyde
23031	25	.8218	93.54	1.4 s. b.	1.85	tr. pink	slight	none	pr. brown	pr. yellow, pr. fluor.	Excess acid, fusel oil, aldehyde
23262	30	.8218	93.54	2.3 s. o. r.	1.50	pink	none	v. faint	pr. brown	f. yellow, f. fluor.	Excess solids, aldehyde

TABLE XXXIV.—ALCOHOL—*Continued.*

Station Number.	Price per 8 ounces.	Spec. gravity at 15.6° C.	Alcohol by volume.	Solids in 50 cc. of alcohol, and color of solids.	Acidity of 50 cc. (cc. N-50 KOH)	Furfurol. (Aniline HCl test). Color.	Fusel oil. Krauch test for odor.	Tests for Aldehyde, etc. Caustic potash. Color.	Silver nitrate. Color.	Meta-phenylene-diamine hydrochloride. Color.	‡ Remarks.
	cts.			mgms.							
23008	30	.8219	93.52	4.6 y.	1.90	orange	none	pr.	v. pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23119	30	.8220	93.49	2.4 s. o. r.	1.50	tr. pink	slight	v. faint	pr. brown	pr. yellow, pr. fluor.	Excess solids, fusel oil, aldehyde
23208	30	.8220	93.49	4.7 s. y.	2.50	pink	slight	v. faint	pr. brown	f. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
22304	30	.8221	93.47	4.0 f. b.	4.50	orange	slight	pr.	v. pr. brown	v. pr. brown, f. fluor.	" " " " " "
23231	30	.8225	93.36	3.1 s. b.	1.65	pink	slight	pr.	pr. brown	pr. brown, v. f. fluor.	Excess solids, fusel oil, aldehyde
23051	30	.8228	93.29	2.6 y.	2.25	tr. pink	slight	none	pr. brown	f. yellow, pr. fluor.	Excess solids, acid, fusel oil, aldehyde
23157	25	.8229	93.26	3.4 v. s. b.	1.70	tr. pink	none	none	f. brown	pr. brown, f. fluor.	Excess solids, aldehyde, odor wnt'green
23290	30	.8229	93.26	2.3 v. s. y.	1.85	pink	none	faint	f. cloud	pr. brown, no fluor.	Excess solids, acid, aldehyde
23155	25	.8230	93.23	2.5 v. s.	3.75	none	none	none	f. brown	none	Excess solids, acid
22302	*15	.8231	93.20	2.6 s. b.	1.35	pink	slight	none	f. opal	f. brown, no fluor.	Excess solids, fusel oil, aldehyde
23278	25	.8233	93.14	2.0 s. y.	2.25	pink	slight	faint	pr. brown	pr. brown, f. fluor.	Excess acid, fusel oil, aldehyde
23140	25	.8236	93.06	2.4 v. s. b.	3.45	tr. pink	slight	v. faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23012	30	.8239	92.97	56.2 y. b.	1.60	pink	slight	pr.	pr. brown	pr. brown, no fluor.	Excess solids, fusel oil, aldehyde
23165	25	.8239	92.97	3.5 s. y. b.	1.00	none	slight	v. faint	f. brown	pr. yellow, pr. fluor.	" " " " "
23125	30	.8240	92.94	2.5 s. b.	1.95	tr. pink	none	pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23009	30	.8240	92.94	0.9 s. b.	1.40	pink	slight	none	pr. brown	none, v. f. fluor.	Excess fusel oil, aldehyde.
23214	30	.8244	92.83	4.1 y.	8.00	orange	slight	v. pr.	v. pr. brown	v. pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23330	25	.8244	92.83	2.7 v. s. y.	2.35	pink	none	v. faint	f. brown	f. brown, no fluor.	Excess solids, acid, furfurol
23129	30	.8246	92.77	4.1 s. o. b.	2.00	none	none	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23166	25	.8249	92.68	2.8 v. s. y.	2.40	tr. pink	none	v. faint	f. brown	f. brown, no fluor.	Excess solids, acid
23027	25	.8249	92.68	3.1 s. b.	2.00	tr. pink	slight	pr.	f. brown	f. brown, f. fluor.	Excess solids, acid, fusel oil, aldehyde
23128	30	.8250	92.66	1.8 v. s. y.	1.70	none	none	none	pr. brown	f. brown, no fluor.	Excess aldehyde
23196	30	.8251	92.63	1.9 s. y.	0.90	pink	none	v. faint	f. brown	f. brown, no fluor.	Excess furfurol
23327	25	.8252	92.60	3.3 s. o. r.	2.90	pink	none	pr.	pr. brown	v. pr. brown, no fluor.	Excess solids, acid, aldehyde
23222	25	.8253	92.57	3.9 o. b.	2.25	pink	slight	pr.	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23102	30	.8256	92.48	2.5 s. o. b.	2.20	pink	none	faint	pr. brown	f. brown, no fluor.	Excess solids, acid, aldehyde
23230	25	.8260	92.36	4.8 v. s. y.	4.50	pink	slight	faint	pr. brown	f. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23065	25	.8261	92.33	3.4 s. b.	1.65	pink	none	faint	pr. brown	none	Excess solids, aldehyde
23267	25	.8265	92.21	3.9 v. s. y.	3.10	pink	slight	faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, fusel oil, aldehyde
23153	†25	.8269	92.08	3.8 s. y. b.	2.00	tr. pink	none	v. faint	pr. brown	pr. brown, no fluor.	Excess solids, acid, aldehyde
23326	25	.8278	91.81	5.3 v. o.	4.50	orange	none	v. pr.	v. pr. brown	v. pr. brown, no fluor.	" " " "
23095	25	.8486	85.39	3.1 v. s. y.	1.35	none	none	none	f. brown	none	Excess solids, low alcohol

DILUTED ALCOHOL (*Alcohol Dilutum*).

by volume, with an average of 93.47. The deficient sample contained only 85.39 per cent. Another sample, sold as "Diluted Alcohol," contained 48.91 per cent. of alcohol by volume, corresponding exactly with the U. S. P. standard for that material.

24 samples ranged from	....	94.87 to 94.00 per cent.
26 " " "	....	93.95 to 93.00 "
19 " " "	....	92.97 to 91.81 "
1 sample was below 90.00 per cent.		

Solids on Evaporation. On evaporating 50 cc. of alcohol a residue was obtained in every case, ranging from 0.7 to 56.2 mgms., with an average of 3.6 mgms. The extremes are equivalent to .0017 and .1364 per cent., respectively.

In 22 samples solids were under	....	2.0	mgms.
" 38 " " " from	....	2.1–4.0	"
" 10 " " " "	....	4.1–9.0	"
" 1 " " "	....	56.2	"

The solids in **23012**, 56.2 mgms., are very excessive.

The color of the solids showed a wide range from none at all in one sample to various shades of brown, yellow and orange red in the others. The color was absent or very slight in twenty-four samples, slight in thirty-five, pronounced in nine and very intense in three. The samples showing more than slight color were as follows:

23098 brown.	23011 orange red.
23007 "	23012 yellow brown.
23010 yellow.	23222 orange brown.
23008 "	23052 very yellow.
23051 "	23326 very orange.
23214 "	23118 very yellow brown.

Acidity. The results for acidity are expressed in cubic centimeters of fiftieth-normal potash necessary to neutralize 50 cc. of alcohol, using phenolphthalein as the indicator. The U. S. P. gives no quantitative method for acidity, but simply requires that 50 cc. shall not affect the color of either blue or red litmus paper moistened with water. It is true, of course, that traces of free acid exist in alcohol* insufficient to affect litmus paper. The indicator used by us, phenolphthalein, would detect much

* Schweissinger, Repert. Chem. Zeit., 1887, p. 174.

smaller quantities of acid than litmus and the test we used is admitted to be unnecessarily severe. It was conducted simply for the purpose of studying the acidity conditions of the alcohol on the market. The Swiss Excise Department* found that in 1070 samples of alcohol a maximum of 3.2 cc. and a minimum of 0.5 cc. of twentieth-normal soda were necessary to neutralize the acidity of 100 cc. of alcohol, using phenolphthalein as indicator. These quantities would be equivalent to 4.0 cc. and 0.6 cc. respectively of fiftieth-normal alkali for 50 cc. of alcohol. Schweissinger† found that 0.4 cc. of $\frac{N}{10}$ soda was required to neutralize the free acid in 100 cc. of a good alcohol; this is equivalent to 1.0 cc. of fiftieth normal alkali for 50 cc.

Our samples range from 0.75 cc. to 10.85 cc. of alkali for 50 cc., showing much greater variations than found by the Swiss Excise Department, and equivalent to .0022 to .0317 per cent. of acetic acid. Only eleven samples fall below the limit set by Schweissinger. In two samples, **23214** and **23055**, the acidities, 8.00 and 10.85 cc. respectively, were very excessive.

11	samples	required	less than	1 c.c.	$\frac{N}{50}$ alkali.
33	"	"	from	1.10 to 2.00 c.c.	"
21	"	"	"	2.10 to 4.00 c.c.	"
4	"	"	"	4.10 to 6.00 c.c.	"
2	"	"	over	6.00 c.c.	"
			Average,	2.17 c.c.	

Furfurol. The U. S. P. gives no specific test for this aldehyde, and we have used the method given by Krauch and referred to on a previous page. Absolute alcohol subjected to this test gave a completely negative result. 0.1 cc. of furfurol was added to 10 cc. of absolute alcohol and 0.05 cc. of this mixture added to another 10 cc. portion of absolute alcohol. The addition of ten drops of aniline and three drops of hydrochloric acid gave a faint but distinct pink color; the dilution was equivalent to about one part in 20,000.

15 samples gave no reaction for furfurol.
19 " " slight reaction for furfurol.
37 " " strong reaction for furfurol.

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* Chem. Ztg., 1893, No. 84.
† *Loc. cit.*

Fusel Oil. The U. S. P. method did not give satisfactory results in our hands, so that used by the Swiss Excise Department was employed. In some cases a foreign odor was apparent, which did not resemble fusel oil.

39 samples gave no odor of fusel oil.
31 " " slight odor of fusel oil.
1 " " strong odor of fusel oil.

Aldehydes, Oak Tannin and Other Organic Impurities. Three tests were used for the detection of aldehydes. The meta-phenylene-diamine hydrochloride test of Windisch is an important one for impurities peculiar to the first runnings of the distillation, and especially for acetaldehyde. In applying this test we found that many samples gave a brownish color without fluorescence, while others gave a strong fluorescence. As a result of our experiments it would seem that the fluorescence is the characteristic part of the test, and that too much stress must not be placed on the simple appearance of a yellow or brownish color. An effort to make approximately quantitative determination of aldehyde by this method, using solutions of known aldehyde content for comparison, was unsuccessful, chiefly due to color present apparently not entirely due to aldehydes.

The silver nitrate test shows the presence not only of aldehyde but of other organic impurities as well. The caustic potash test likewise does not reveal aldehyde alone, for if the alcohol has been stored in casks made of wood, containing tannin, it will show a color with this test.

The following tabulation shows the results secured by the different tests singly, by any two or by all three, the figures representing the number of samples giving the test. These are classed as negative, faint or pronounced.

	Negative.	*Faint.*	*Pronounced.*
Potash	22	31	18
Silver nitrate	3	27	41
Windisch	11	20	40
Potash and silver nitrate	2	12	16
Potash and Windisch	6	12	16
Silver nitrate and Windisch	0	14	27
All	0	7	16

In other words, twenty-two samples gave negative results with potash, thereby satisfying the U. S. P. requirement. Thirty-one

gave a faint test, while eighteen gave a pronounced test. With silver nitrate, thirty samples gave negative or faint tests, the U. S. P. limit, while forty-one gave a pronounced discoloration. With the unofficial Windisch test, thirty-one gave negative or faint reactions, while forty gave a pronounced color with fluorescence. The silver and Windisch tests, therefore, appear to be more delicate than the potash test. These two tests likewise agreed very closely in the total number of samples giving a pronounced test, although in only twenty-seven of the forty-one samples were the tests pronounced hy both methods in the same samples. The same number of samples, sixteen, gave pronounced tests with potash and silver nitrate, and with potash and the Windisch test, but not always on the same samples. None of the seventy-one samples gave negative reactions with all three tests, while seven gave faint and sixteen pronounced colors.

The following tabulation summarizes our examination, in which the samples passed contained not less than 92 per cent. of alcohol, not over 2.0 mgms. solids, not over 1.7 cc. acidity, no fusel oil, and gave only slight reactions for aldehydes and furfurol.

5	passed.		
2	contain	fusel oil.	
2	"	excess solids.	
1	"	"	acid.
4	"	"	aldehyde.
1	"	"	solids, low alcohol
3	"	"	solids, acid.
1	"	"	solids, fusel oil.
7	"	"	solids, aldehyde.
1	"	"	acid, aldehyde.
5	"	"	fusel oil, aldehyde.
1	"	"	solids, fusel oil, acid.
7	"	"	solids, fusel oil, aldehyde.
15	"	"	solids, acid, aldehyde.
4	"	"	acid, fusel oil, aldehyde.
12	"	"	solids, acid, fusel oil, aldehyde.

BISMUTH SUBNITRATE.

(*Bismuthi Subnitras.*)

"Bismuth subnitrate should yield not less than 80 per cent. of pure bismuth oxide." *U. S. P.*

The twenty-five samples examined were pure, none of them containing either arsenic, lead, copper, ammonia, chlorides, carbonates or sulphates.

Bismuth oxide, determined by the U. S. P. method, ranged from 82.36 to 80.01 per cent., with an average of 80.77 per cent.

The moisture limit of the U. S. P. is 3 per cent. The samples ranged from 2.98 to 4.18, with an average of 3.52 per cent.

TABLE XXXV.—BISMUTH SUBNITRATE.

Station number.	Price of material. cts.	Weight. Claimed. oz.	Weight. Found. oz.	Water.	Bismuth Oxide (Bi_2O_3).
23088	25	1	0.84	3.29	82.36
23152	40	2	1.80	3.49	82.30
23146	30	2	1.84	3.71	82.01
23175	25	1	0.94	3.58	82.01
23239	25	1	0.87	4.06	81.32
23204	25	1	0.94	3.91	81.18
23234	25	1	0.81	3.19	81.14
23301	20	1	1.13	3.16	81.10
23033	40	2	2.00	3.47	80.79
23199	25	1	1.03	3.39	80.72
23282	25	1	0.94	3.16	80.70
23238	20	1	0.97	2.98	80.64
22308	40	2	*	4.13	80.60
23198	25	1	1.10	3.43	80.54
23257	25	1	0.97	3.67	80.31
23169	50	2	1.90	3.62	80.31
23276	30	1	0.94	3.58	80.27
23258	25	1	1.32	3.44	80.16
23329	25	1	0.94	4.18	80.15
23181	25	1	0.90	3.67	80.08
23113	25	1	0.90	3.01	80.08
23217	25	1	1.00	3.90	80.07
23227	35	1	1.07	3.46	80.07
23259	25	1	0.90	3.65	80.04
23023	45	2	1.87	3.47	80.01

* Sample not weighed through oversight.

There was no serious excess of moisture in any case, yet only one sample fell within the U. S. P. limits.

The price of the material ranged from 20 to 35 cents for one ounce, and from 30 to 50 cents for two ounces, the usual wide variations noticed in nearly all drug products we have examined. There was a general tendency toward short weight, only seven samples equalling or exceeding the weight asked for. The greatest deficiency in weight amounted to 19 per cent.

SPIRIT OF CAMPHOR.

(Spiritus Camphoræ.)

According to the U. S. P., spirit of camphor should be made by dissolving 100 grams of camphor in 800 cc. of alcohol, filtering through paper, and passing sufficient alcohol through the filter to make a volume of 1,000 cc.

Spirit of camphor made according to the above directions in this laboratory contained 10 per cent. of camphor and 86.31 per cent. of alcohol by volume, and showed a specific gravity of 0.8223 at 25° C.

Of the sixty-nine samples examined, twenty-three contained 10 per cent. or more of camphor, with satisfactory percentages of alcohol; thirty-one samples, containing between 9 and 10 per cent. of camphor, were passed; while fifteen samples were decidedly below standard, twelve in camphor, two in alcohol, and one in both camphor and alcohol. (See Tables XXXVI to XXXVIII.)

The following tabulation shows the range in composition of all the samples:

	Max.	Min.	Ave.
Specific gravity	0.8842	0.8150	0.8296
Alcohol by volume	88.66	67.00	84.44
Camphor	13.6	5.4	9.6

No synthetic camphor or wood alcohol was detected in any of the samples. Careless labeling was observed in two samples, one being marked "Sweet Spts. Nitre," the other "Cholera Drops."

TABLE XXXVI.—SPIRIT OF CAMPHOR UP TO STANDARD.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24047	20	.8312	82.19	13.6	24092	35	.8279	84.72	10.2
24089	30	.8392	80.33	12.9	23966	30	.8293	84.34	10.2
24055	25	.8317	82.88	11.8	24052	25	.8294	84.31	10.2
24074	25	.8292	83.75	11.5	24075	25	.8273	84.95	10.1
24077	20	.8294	83.69	11.5	*24096	35	.8338	83.17	10.1
23971	15	.8281	84.34	10.9	24104	30	.8250	85.62	10.0
23967	20	.8258	85.07	10.7	24045	15	.8253	85.55	10.0
24082	25	.8332	83.05	10.7	24037	30	.8261	85.32	10.0
24044	25	.8289	84.24	10.6	23970	20	.8266	85.17	10.0
24078	15	.8261	85.10	10.5	24053	35	.8279	84.81	10.0
24076	20	.8309	83.75	10.5	24043	20	.8290	84.51	10.0
24061	25	.8236	85.83	10.3					

* Labeled "Sweet Spts. Nitre."

TABLE XXXVII.—SPIRIT OF CAMPHOR PASSED.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24101	35	.8264	85.29	9.9	24083	25	.8287	84.84	9.5
24091	35	.8255	85.59	9.8	24038	30	.8273	85.25	9.4
24072	25	.8274	85.05	9.8	24035	25	.8275	85.22	9.4
24068	25	.8275	85.02	9.8	23964	20	.8235	86.37	9.3
24067	25	.8280	84.87	9.8	23969	15	.8262	85.59	9.3
24063	25	.8313	84.00	9.8	24090	35	.8307	84.40	9.3
24046	20	.8258	85.55	9.7	24087	20	.8313	84.22	9.3
24025	25	.8269	85.24	9.7	24041	20	.8150	88.52	9.2
24051	20	.8276	85.04	9.7	24036	35	.8237	86.38	9.2
24056	15	.8280	84.94	9.7	24073	25	.8276	85.28	9.2
24081	35	.8303	84.31	9.7	24054	25	.8237	86.43	9.1
24062	25	.8245	85.95	9.6	24026	30	.8249	86.07	9.1
24079	20	.8253	85.85	9.6	*24042	35	.8298	84.76	9.1
24057	20	.8278	85.06	9.6	23968	25	.8271	85.49	9.0
24027	25	.8241	86.12	9.5	†24088	20	.8273	85.44	9.0
24065	25	.8259	85.61	9.5					

* Labeled "Alcohol 94%." † Labeled "Cholera Drops."

TABLE XXXVIII.—SPIRIT OF CAMPHOR BELOW STANDARD.

Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.	Station No.	Cost per 4 oz.	Specific gravity at 25° C.	Alcohol by volume.	Camphor.
	cts.					cts.			
24048	20	.8743	69.55	10.9	24080	30	.8285	85.59	8.1
24102	30	.8687	72.11	9.0	24099	25	.8280	85.75	8.0
24071	25	.8251	86.15	8.8	24103	20	.8290	85.55	7.9
24098	25	.8309	84.58	8.8	24093	20	.8276	86.02	7.7
24097	25	.8257	86.09	8.7	24064	20	.8842	67.00	7.2
24100	25	.8290	85.15	8.7	23963	20	.8210	88.25	6.8
24086	15	.8327	84.17	8.6	24028	15	.8219	88.66	5.4
23965	20	.8227	86.97	8.5					

Another sample bore the impossible guarantee of 94 per cent. alcohol.

The cost of the spirit ranged from 15 to 35 cents for four ounces, with an average of 24.4 cents.

Methods of Analysis.

Camphor. Ordinary camphor is dextro-rotary, the apparent rotation varying with the nature of the solvent and the concentration of the solution. When the proportion of camphor in an alcoholic solution is roughly known, therefore, the optical activity of the liquid indicates the amount of camphor present only approximately, unless the strength of the alcohol is also known. In the ordinary samples of spirit of camphor

the variations in alcohol content are relatively small, in sixty-six of our sixty-nine samples from 80 to 88 per cent., and the amount of camphor present may be determined with reasonable accuracy by the use of tables based on a 10 per cent. solution of camphor in 86 per cent. alcohol.

In the effort to ensure greater accuracy the method of O. Schmatolla, as given in Squire's Companion to the British Pharmacopœia, 1908, p. 309, was tried.

In our trials with the method a Gottlieb fat tube was used, graduated in one-fifth c.c. While with our standard spirit of camphor we secured satisfactory results, the use of a burette where each c.c. was equivalent to about 10 per cent. of camphor seemed to offer too large an opportunity for error to warrant the use of the method. Accordingly a series of observations was made in a 200 mm. polariscope tube at 25° C., using solutions of varying strength of camphor in 86 per cent. alcohol. A color screen, consisting of a 50 mm. tube filled with 10 per cent. potassium bichromate was used to correct for the dispersion of the camphor. The following tabulation based on these observations was employed in calculating the results given in the tables. It was shown that every 1.2 divisions on the scale was approximately equal to 0.5 per cent. of camphor.

POLARIZATION OF CAMPHOR IN 200 MM. TUBE AT 25° C., ALCOHOL 86 PER CENT.

Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.	Reading 200 mm. 25° C.	Camphor Per cent.
1.2	0.5	7.1	3.0	13.0	5.5	19.1	8.0
2.5	1.0	8.2	3.5	14.2	6.0	20.3	8.5
3.8	1.5	9.3	4.0	15.4	6.5	21.5	9.0
5.1	2.0	10.6	4.5	16.7	7.0	22.7	9.5
6.1	2.5	11.8	5.0	17.9	7.5	24.0	10.0

Alcohol. The volatility of camphor renders difficult the determination of alcohol by distillation, even after the camphor has been partially separated by the addition of water. Furthermore, this separation is rarely complete and sometimes impossible.* We therefore employed for the determination of alcohol the formula given by Hortvet and West,† where the determination of the camphor and the specific gravity of the spirit affords sufficient data to calculate exactly the percentage of alcohol present.

SOLUTION OF FORMALDEHYDE.

(*Liquor Formaldehydi.*)

The U. S. P. defines this as "an aqueous solution, containing not less than 37 per cent., by weight, of absolute formaldehyde."

* Allen's Comm. Organic Anal., 1907, *2*, pt. 3, p. 370.

† Jour. Ind. and Eng. Chem., 1909, *1*, p. 94.

Methods of Analysis.

Specific Gravity. Determined by pycnometer at 25° C.

Formaldehyde. The U. S. P. and the A. O. A. C. methods for the assay of formaldehyde are both based on the Blank and Finkenbeiner hydrogen peroxide method. The two modifications differ considerably in details, and either in the form written may lead to erroneous results in careless hands. Haywood and Smith* have shown the advisability of adding the formaldehyde to the soda and peroxide instead of *vice versa.* Measuring 3 c.c. of the formaldehyde from a small pipette also certainly offers less chance of error than weighing 3 c.c. in a 500 c.c. Erlenmeyer flask. The U. S. P. method takes cognizance of the fact, apparently overlooked in the A. O. A. C. method, that hydrogen peroxide is generally decidedly acid in its reaction, and that correction should be made for the same. In our examination of hydrogen peroxide last year we found the acidity of 50 c.c. to range from 0.19 to 1.85 c.c. of normal alkali, which would cause a plus error in the formaldehyde determination of from 0.18 to 2.03 per cent. depending upon the brand of peroxide used. As all our determinations were made at the same time, the peroxide was neutralized before using instead of making a correction in each individual determination.

The method we used was exactly that given in Bull. 107 (revised), Bur. of Chem., U. S. Dept. of Agr., p. 33, except that the peroxide was neutralized with soda before using. In those samples not up to the U. S. P. standard of 37 per cent., a test was also made by the U. S. P. method. The differences in the results by the two methods were trifling.

Acidity. 20 c.c. of the solution, to which two drops of phenolphthalein had been added, were titrated with normal soda.

Fixed Impurities. 20 c.c. of the solution were evaporated to dryness on a water bath, and the residue ignited.

Eleven samples of formaldehyde were examined; the results are given in Table XXXIX.

The samples range from 37.59 to 34.25 per cent. of formaldehyde, only one sample, **24022,** being much below standard strength. The specific gravity ranged from 1.0615 to 1.0815, somewhat wider than the limits set by the U. S. P., 1.075 to 1.078. The acidity ranged from 0.25 to 1.33 cc. normal alkali per 20 cc. of solution, two samples, **24039** and **24105,** exceeding the 0.5 cc. limit of the U. S. P. The residues from ignition after the evaporation of 20 cc. ranged from none at all to 9.8 mgms. The highest residue amounted to only 0.04 per cent., and did not warrant a further examination as to the nature of this slight impurity.

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* Jour. Amer. Chem. Soc., 1905, 27, 1183.

TABLE XXXIX.—SOLUTION OF FORMALDEHYDE.

Station number.	Brand.	Specific gravity at 25° C.	Formaldehyde A. O. A. C. Method.	Formaldehyde U. S. P. Method.	Acidity of 20 cc. equal to cc. N. alkali.	Residue from evaporation and ignition of 20 cc.	Remarks.
			%	%	cc.	mgms.	
24070	Prepared for The Lee & Osgood Co., Norwich	1.0748	37.59	....	0.37	4.7	
24032	*Lehn & Fink, N. Y.	1.0725	37.44	....	0.40	5.8	
24039	" " " "	1.0667	37.15	....	1.12	0.6	High acidity
24023	Not given	1.0724	37.13	....	0.38	9.8	
24024	*Merck	1.0765	37.06	...	0.25	1.8	
24060	* "	1.0687	37.00	....	0.27	0.0	
24050	"	1.0783	36.93	36.89	0.25	0.9	
24040	Lehn & Fink, N. Y.	1.0615	36.88	36.79	0.30	0.9	
24105	Powers-Weightman-Rosengarten Co.	1.0815	36.44	36.38	1.33	0.6	High acidity
24031	*Westport Chem. Co.	1.0705	36.38	36.31	0.50	5.2	
24022	*Merck	1.0605	34.25	34.40	0.50	2.4	Below standard

* Statement of dealer.

FOWLER'S SOLUTION (SOLUTION OF POTASSIUM ARSENITE).

(Liquor Potassii Arsenitis.)

This is defined by the U. S. P. as "an aqueous solution, which should contain potassium arsenite corresponding in amount to 1 per cent. of arsenic trioxide."

This preparation has a wide use as a medicine and is generally employed when arsenic is given internally. Inasmuch as it contains an active poison, it should conform very closely in composition with the U. S. P. standard. An excess of arsenic trioxide is quite as objectionable as a deficiency. In our tabulation we have arbitrarily classed as up to standard those samples containing over 0.90 per cent. arsenic trioxide. This allowance of 10 per cent. is an exceedingly generous one and it is questionable whether a more rigid adherence to the standard should not be required. McGill* suggests 0.020 per cent. of arsenic as the maximum limit of variability. The color of the solution has not been used in our classification of standard and below standard

* Lab. Int. Rev. Dept., Ottawa, Bull. 175.

solutions, although the data are given in the table. The color, however, is important, as it prevents the mixture being mistaken for water. The reddish-brown color, which standard Fowler's Solution should possess, is due to the red saunders of the compound tincture of lavender which the formula requires. Absence of color or a yellowish color indicates that the formula has not been strictly followed in this respect, and suggests the probable use of spirit of lavender, instead of the compound tincture, a practice permitted by the German Pharmacopœia.

Solutions of alkaline arsenites slowly absorb oxygen from the air, and are in part converted into arsenates. Hence it is advisable that the solution should be kept in small bottles well filled. It has been shown, however, that the alkaline reaction of the official solution somewhat retards this change. The loss of arsenite reduces the therapeutic value of the solution, and to determine the amount of this loss both arsenious and arsenic oxide were determined in all the samples under examination.

The fact that Fowler's Solution contains arsenic brings it under § 4733 of the General Statutes, which requires that the seller "shall affix to the package sold by him a label plainly marked with his name, date of sale, and the word 'poison,' and shall enter on a book kept by him for that purpose the name of the purchaser, date of sale, and the quantity sold." From the experience of the station's agent it is obvious that there is quite a general disregard of this statute on the part of druggists when selling Fowler's Solution. Of the fifty-five druggists selling this arsenical poison, only sixteen required the agent to give his name when purchasing it. One druggist did not even take the precaution of using a poison label.

Fifty-five samples were examined (see Tables XL and XLI). These ranged in total arsenic, calculated as arsenious oxide, from 1.331 to 0.109 per cent. The arsenious oxide ranged from 1.287 to 0.079, and the arsenic oxide from 0.126 to 0.006 per cent.

The following summary of the amounts of the two arsenic oxides found shows the variable composition of the solution as sold in this state:

Arsenious Oxide.		Arsenic Oxide.	
From 0.950 to 1.287	12	From 0.006 to 0.020	9
" 0.907 to 0.946	13	" 0.021 to 0.030	7
" 0.800 to 0.891	19	" 0.031 to 0.040	10

Arsenious Oxide.		Arsenic Oxide.	
From 0.713 to 0.788	5	From 0.041 to 0.050	9
" 0.638 to 0.668	4	" 0.051 to 0.060	12
" 0.079 to 0.252	2	" 0.061 to 0.126	8
	55		55
Average, 0.856		**Average, 0.044**	

Twenty-five samples contained over 0.900 per cent. of arsenious oxide; one of these contained the excessive amount of 1.287 per cent.; twenty-four samples ranged from 0.700 to 0.890 per cent.; while six were less than 70 per cent. U. S. P. strength, two of these, Nos. **23338** and **23319**, showing the very low percentages of 0.252 and 0.079.

The arsenic oxide ranged from 0.006 to 0.126 per cent. In most of the samples the amounts were very small, but in eight cases the arsenic oxide ranged from 0.061 to 0.126 per cent., three samples containing 0.111, 0.126 and 0.115 per cent. respectively. In one sample, No. **23338**, not only was the total arsenic very low, but nearly one-third of it was in the form of arsenate.

TABLE XL.—FOWLER'S SOLUTION UP TO STANDARD.*

Station No.	Price per bottle, cents.	Amount of Material, fl. oz.	Total Arsenic, calculated as As_2O_3.	Arsenious Oxide (As_2O_3).	Arsenic Oxide (As_2O_5).	Color.
			%	%	%	
23331	25	4	1.331	1.287	0.051	Red brown.
23045	45	4	1.040	1.035	0.006	"
23243	25	4	1.025	1.011	0.016	"
23288	35	4	1.040	0.998	0.049	"
23101	20	4	1.015	0.995	0.023	Yellowish.
23317	25	4	1.005	0.974	0.036	Red brown.
23294	30	4	1.005	0.969	0.042	"
23171	25	4	0.985	0.958	0.031	"
23190	35	4	0.965	0.954	0.013	Colorless.
23170	40	4	0.985	0.952	0.038	Red brown.
23108	15	4	0.955	0.950	0.006	"
23090	25	4	0.985	0.950	0.041	Yellowish.
23073	35	4	0.985	0.946	0.045	Red brown.
23064	30	4	0.970	0.946	0.028	"
23303	25	4	0.990	0.945	0.052	"
23116	25	4	0.990	0.942	0.056	"
23177	25	4	0.970	0.940	0.035	"
23335	50	4	0.980	0.939	0.048	"
23189	40	4	0.970	0.938	0.037	"
23271	20	4	0.975	0.934	0.048	"
23224	35	4	0.965	0.926	0.045	"
23091	35	4	0.950	0.922	0.032	"
23141	25	4	0.921	0.916	0.006	"
23013	35	4	0.941	0.911	0.035	"
23235	30	4	0.965	0.907	0.068	"

* Not more than 10 per cent. below standard strength; color disregarded.

TABLE XLI.—FOWLER'S SOLUTION BELOW STANDARD.*

Station No.	Price per bottle, cents.	Amount of Material, fl. oz.	Total Arsenic, calculated as As_2O_3	Arsenious Oxide (As_2O_3).	Arsenic Oxide (As_2O_5).	Color.
			%	%	%	
23132	25	4	0.916	0.891	0.029	Red brown.
23089	35	4	0.936	0.889	0.055	"
23207	30	4	0.901	0.889	0.014	"
23167	15	4	0.901	0.880	0.024	Light yellow.
23332	35	4	0.926	0.879	0.055	Red brown.
23318	25	4	0.975	0.879	0.111	"
23320	35	4	0.921	0.875	0.054	"
23287	25	4	0.901	0.873	0.033	Yellow.
23280	35	4	0.921	0.871	0.059	Red brown.
23225	25	4	0.926	0.867	0.069	"
23270	25	4	0.881	0.852	0.034	"
23336	40	4	0.901	0.850	0.059	Dark yellow.
23334	40	4	0.921	0.848	0.085	Red brown.
23130	30	4	0.871	0.847	0.028	"
23117	30	4	0.886	0.845	0.048	"
23286	15	3	0.881	0.824	0.066	Yellow.
23337	40	4	0.931	0.822	0.126	Dark yellow.
23150	35	4	0.832	0.812	0.023	Red brown.
23216	35	4	0.812	0.800	0.014	"
23149	25	3	0.832	0.788	0.051	Yellowish.
23305	25	4	0.777	0.733	0.051	Red brown.
23134	35	4	0.743	0.727	0.019	Yellowish.
23260	15	4	0.767	0.723	0.051	Red brown.
23333	45	4	0.762	0.713	0.057	Yellow.
23304	35	4	0.688	0.668	0.023	"
23289	20	4	0.678	0.668	0.012	Red brown.
23261	20	4	0.708	0.652	0.065	Yellow.
23151	60	4	0.673	0.638	0.041	Yellowish.
23338	30	4	0.351	0.252	0.115	Dark yellow.
23319	25	4	0.109	0.079	0.037	Red brown.

* Over 10 per cent. below standard strength.

The solutions showed wide differences of color. Forty had the proper red-brown shade, fourteen varied from yellowish to dark yellow and one was colorless.

All the samples showed an alkaline reaction and had an aromatic odor.

The cost ranged from 15 to 60 cents per four ounces, with an average of 30.3 cents. The highest price was charged for one of the samples of lowest grade.

Methods of Analysis.

Arsenious Oxide. The U. S. P. method was followed using 25 gms. of solution instead of 24.6 gms.

Arsenic Oxide. The qualitative method of Lyons* was used as a preliminary test. The method follows: Shake 5 c.c. of the solution with

* Chem. Zentrabl., 1909, *80*, p. 54.

0.5 c.c. of magnesia mixture, allow to settle, pour off solution, and wash precipitate with 5 c.c. of water. Decant again and add to the residue a few drops of silver nitrate and a drop of acetic acid. If more than a trace of arsenate be present a chocolate-colored precipitate of silver arsenate will be formed.

In the effort to secure a definite means of comparison the precipitates were whirled for one minute in the centrifuge in tubes of small bore. The results, however, were not entirely satisfactory. The following quantitive method was then used: Weigh 10 gms. of solution into a 150 c.c. flask, transferring with water and boil until volume is about 10 c.c. Cool to about 80° C. and add an equal volume of concentrated hydrochloric acid and one gram of potassium iodide, mix and allow to stand for ten minutes to reduce arsenic to arsenious oxide. Transfer to a 500 c.c. Erlenmeyer flask and dilute with cold water, and add carefully tenth-normal sodium thiosulphate solution until the solution is exactly colorless. Make solution slightly alkaline with sodium carbonate, then make slightly acid with hydrochloric acid. Add sodium bicarbonate in excess and titrate with tenth-normal iodine solution, using starch as indicator.* From the total arsenious oxide thus found and the arsenious *oxide found originally the amount of arsenic present as arsenate may* be easily calculated.

TINCTURE OF GINGER.

(*Tinctura zingiberis.*)

The U. S. P. requires that tincture of ginger should be made by macerating 200 grams of ginger root, No. 50 powder, with strong alcohol by the usual process, with subsequent percolation, and adding sufficient alcohol to the percolate to obtain 1,000 cc.

We have already shown under Ginger Extract on page 499, that such a preparation should have a specific gravity of about 0.820 at 15.6° C., and should contain at least 93 per cent. alcohol *by volume, and from 0.97 to 1.94 per cent. of solids, which should* be almost completely soluble in 95 per cent. alcohol and only slightly soluble in cold water.

Fourteen samples were bought from druggists. Twelve of these proved to be tinctures of full standard quality. Two were below standard, one because of a deficiency in alcohol, and both showing solids of low alcohol- and high water-solubility. Although tincture of ginger and standard ginger flavoring extract are identical in strength, it is noticeable that the purity of the tincture as dispensed by druggists is very much higher

* U. S. Dept. Agl., Bur. of Chem., Bull. 107 (revised), p. 25.

than that of the extract. While 86 per cent. of the tinctures were pure, of the flavoring extracts only 21 per cent. were pure.

The following table shows the average composition of the laboratory samples, the standard tinctures, and the two samples below standard:

	Laboratory Samples.	*Standard Tinctures.	Tinctures Below Standard.
Specific gravity @ 15.6° C.	.8220	.8271	.8473
Alcohol by volume	93.92	93.33	89.62
Total solids	1.62	1.36	2.41
Solids soluble in alcohol	1.62	1.30	1.54
Solids soluble in water	0.19	0.23	0.90
Per cent. of solids sol. in alcohol	100	96	64
Per cent. of solids sol. in water.	12	17	37

The sampling agent was instructed in every case to ask for tincture of ginger, and it is a striking fact that in only two of the fourteen samples was the preparation labeled "tincture." Six samples were labeled "extract," five "essence," and one very carelessly "Jamaica Rum." There should be no such confusion in nomenclature and when dispensing an official preparation the druggist should certainly give it its official name, espec-

TABLE XLII.—TINCTURE OF GINGER.

Station No.	Label.	Price per 4 oz., cents.	Specific gravity at 15.6° C.	Alcohol by volume.	Solid matter. Total.	Solid matter. Soluble in alcohol.	Solid matter. Soluble in water.	Per cent. of total solids soluble In alcohol.	Per cent. of total solids soluble In water.
24965	Ext. Jamaica Ginger	20	.8265	95.07	1.51	1.51	0.16	100	11
25060	Jamaica Rum	35	.8249	94.85	1.43	1.33	0.33	93	23
25030	Extract Jamaica Ginger	25	.8247	94.56	1.10	1.10	0.16	100	15
24940	Ext. Jamaica Ginger	*15	.8255	94.12	1.00	1.00	0.14	100	14
24984	Extract of Jamaica Ginger..	25	.8359	93.89	2.23	1.23	0.68	†55	30
25017	Ext. Jamaica Ginger	20	.8332	93.78	1.68	1.49	0.47	89	28
24964	Ess. Jam. Ginger	35	.8295	93.49	1.34	1.31	0.18	98	13
24941	Ess. Jamaica Ginger	*15	.8310	93.33	1.34	1.16	0.31	87	23
24985	Ext. Jamaica Ginger	25	.8294	93.16	1.20	1.16	0.20	97	17
25035	Ess. Jamaica Ginger	30	.8254	93.13	1.31	1.30	0.12	99	9
25058	Tr. Ginger	35	.8224	92.26	1.19	1.14	0.23	96	19
25034	Essence of Jamaica Ginger .	30	.8258	91.65	1.61	1.55	0.16	96	10
25075	Essence of Jamaica Ginger .	25	.8274	90.52	1.59	1.58	0.29	99	18
24998	Tinct. Ginger..............	25	.8587	85.34	2.59	1.84	1.12	†71	43
----	Made in laboratory (Jamaica Ginger)	....	.8198	94.63	1.43	1.42	0.21	99	15
----	Made in laboratory (African Ginger)............	....	.8222	93.21	1.81	1.81	0.16	100	9

* 2 oz. † Solubility too low for a standard tincture.

ially when the purchaser asks for it under that name. The name "essence" is usually associated with a preparation of low alcoholic strength, and the druggists themselves do their own preparations an injustice, in the five cases cited, by using this name instead of "tincture."

The cost of the tinctures was fifteen cents for two ounces, and from fifteen to thirty-five cents for four ounces, showing the usual wide variations in price of drug preparations sold in this state.

OLIVE OIL.

(*Oleum Olivae.*)

Seventy-three samples were bought from druggists, all but four being sold under the druggist's label. Sixty-three samples were not found adulterated, while ten were adulterated, three with cottonseed oil, three with peanut oil and four with sesame oil. The analyses are given in Tables XLIII and XLIV.

The range in the various determinations was as follows:

	Pure Samples.	Cottonseed Oil.	Samples containing. Peanut Oil.	Sesame Oil.
Specific Gravity..	0.915-0.917	0.916-0.923	0.915-0.916	0.915-0.916
Index of refraction	1.4699-1.4708	1.4712-1.4743	1.4702-1.4705	1.4699-1.4707

From the above figures it is seen that olive oil may be adulterated with peanut or sesame oil without materially affecting the specific gravity. Cottonseed oil, on the other hand, causes a decided increase in gravity. The same remarks apply to the index of refraction, cottonseed oil alone of the three oils causing a wide variation from the normal. The importance of applying the specific tests for foreign oils is therefore apparent.

Samples **24916** and **24138** consist almost, if not entirely, of cottonseed oil. Sample **24138** was labeled "sweet oil," which according to the U. S. Dispensatory is a synonym for olive oil.

In applying the Renard test for peanut oil the melting point of the resultant arachidic acid was determined in each case, and found to correspond with the accepted value for that fatty acid.

The price of the oil ranged from ten to twenty-five cents for four ounces.

The olive oil sold by druggists in this state has been inspected six times, and, while a slight improvement in purity has been

TABLE XLIII.—OLIVE OIL NOT FOUND ADULTERATED.

Station No.	Brand.	Place of Sampling.	Price of 4 oz., cents.	Specific gravity at 15.5° C.	Index of Refraction at 15.5° C.
25059	Druggist's label	Bethel	15	0.916	1.4703
24944	" "	Bridgeport	20	0.916	1.4707
24945	" "	"	15	0.916	1.4702
24946	" "	"	20	0.915	1.4704
24947	" "	"	15	0.916	1.4703
24948	" "	"	25	0.916	1.4702
24949	" "	"	15	0.915	1.4702
24950	" "	"	15	0.916	1.4702
24951	" "	"	20	0.916	1.4703
25056	McKesson & Robbins, N. Y. Excelsior Brand	Danbury	25	0.915	1.4702
25057	Druggist's label	"	20	0.916	1.4703
25062	" "	"	25	0.916	1.4708
25063	" "	"	25	0.916	1.4705
24912	" "	Hartford	20	0.916	1.4703
24913	" "	"	20	0.915	1.4704
24914	" "	"	15	0.915	1.4701
24915	" "	"	20	0.915	1.4707
24917	" "	"	10	0.915	1.4707
24922	" "	"	15	0.916	1.4700
24923	" "	"	15	0.915	1.4703
24924	" "	"	15	0.916	1.4702
24142	" "	Meriden	15	0.916	1.4705
24143	" "	"	15	0.915	1.4705
24144	" "	"	15	0.915	1.4706
24931	" "	Middletown	15	0.916	1.4703
24933	" "	"	15	0.915	1.4703
24151	" "	New Britain	15	0.915	1.4699
24152	" "	" "	15	0.915	1.4701
24153	" "	" "	15	0.915	1.4704
24155	" "	" "	20	0.916	1.4702
24898	" "	New Haven	20	0.916	1.4704
24899	" "	" "	20	0.916	1.4700
24900	" "	" "	20	0.916	1.4702
24160	" "	" "	15	0.915	1.4703
24162	" "	" "	20	0.915	1.4705
24966	" "	" "	10	0.915	1.4703
24967	" "	" "	20	0.915	1.4702
24968	" "	" "	15	0.915	1.4702
24970	" "	" "	10	0.916	1.4705
24986	" "	New London	20	0.915	1.4702
24987	" "	" "	15	0.915	1.4703
25002	" "	Norwich	25	0.915	1.4703
25003	" "	"	20	0.915	1.4702
25004	" "	"	15	0.917	1.4703
25006	" "	"	20	0.915	1.4702
25007	" "	"	15	0.916	1.4701
25037	Lehn & Fink, N. Y., Lucca Cream Virgin Olive Oil	So. Norwalk	*35	0.916	1.4702
25026	A. Gaillard & Fils, Marseille, Olive Oil Sublime Extra	Stamford	*25	0.916	1.4705

* Price per bottle.

TABLE XLIII.—OLIVE OIL NOT FOUND ADULTERATED.—*Con't.*

Station No.	Brand.	Place of Sampling.	Price of 4 oz., cents.	Specific gravity at 15.5° C.	Index of Refraction at 15.5° C.
25027	Druggist's label	Stamford	20	0.917	1.4704
25028	" "	"	15	0.917	1.4704
24115	" "	Waterbury	15	0.916	1.4703
24116	" "	"	15	0.916	1.4706
24117	" "	"	15	0.915	1.4702
24118	" "	"	25	0.915	1.4705
24119	" "	"	15	0.915	1.4705
24120	" "	"	25	0.914	1.4705
24121	" "	"	15	0.915	1.4704
24122	" "	"	18	0.915	1.4705
24969	" "	West Haven	25	0.915	1.4702
24979	" "	" "	20	0.916	1.4702
25012	Benefit Brand Finest Olive Oil	Willimantic	17	0.916	1.4703
25013	Druggist's label	"	15	0.915	1.4703
25014	" "	"	20	0.916	1.4701

TABLE XLIV.—ADULTERATED OLIVE OIL.

	Contains Cotton Seed Oil.				
24916	Druggist's label	Hartford	15	0.921	1.4734
24988	" "	New London	15	0.916	1.4712
24138	" " (Sweet Oil)	Waterbury	15	0.923	1.4743
	Contains Peanut Oil.				
24932	Druggist's label	Middletown	15	0.915	1.4702
24154	" "	New Britain	15	0.916	1.4705
25005	" "	Norwich	25	0.916	1.4703
	Contains Sesame Oil.				
24892	Druggist's label	New Haven	15	0.916	1.4705
25076	" "	Norwalk	15	0.916	1.4705
25036	" "	So. Norwalk	15	0.916	1.4707
25015	" "	Willimantic	15	0.915	1.4699

found this year, that sold by grocers as a rule is shown to be of greater purity. No adulterated olive oil was found in grocers' stocks from 1905 to 1908. The results of the inspection of druggists' samples are shown below.

	Not found Adulterated.	Adulterated.	Per Cent. Adulterated.
1897	13	5	27.8
1900	17	13	43.3
1905	21	9	30.0
1906	55	11	16.7
1907	65	11	14.5
1909	63	10	13.7

PANCREATIN.

(*Pancreatinum.*)

The Pharmacopœia defines pancreatin as "a mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog or the ox, and consisting principally of amylopsin, myopsin, trypsin and steapsin, and proved to be capable, when assayed by the process given below, of converting not less than 25 times its own weight of starch into substances soluble in water."

In addition to this definition it is required to be a cream-colored, amorphous powder, containing not more than 10 per cent. of substances insoluble in water, and should completely peptonize cow's milk under certain fixed conditions.

It is apparent from the above definition that pancreatin should contain all the enzymes of the pancreatic juice, the chief of which are trypsin, which converts coagulable proteins into proteoses and peptones; and amylopsin, or pancreatic diastase, which converts starch to dextrin and maltose. Myopsin, which coagulates milk casein, and steapsin, which emulsifies fats, are also normal constituents of the pancreatic juice.

In the examination herein reported only the proteolytic and the amylolytic powers of the pancreatin were tested. The samples were examined, however, for water-insoluble matter, and for starch and reducing sugars.

Thirteen samples were examined; these are believed to represent all the brands on the Connecticut market. Five of these came to us as the product of four manufacturers; the others simply bore the druggist's label.

Table XLV shows the results of our examination.

Color and Appearance. Eight of the samples were amorphous powders, varying in color from yellow-white to cream-white. Four of the samples occurred in yellow-white to dirty-yellow lumps of a sticky consistence. No. 23111 was a deep-yellow powder. Only eight of the thirteen samples, therefore, satisfied the U. S. P. requirements as to color and appearance.

Cost of Material. The cost of the samples showed a wide range. In most cases one-half ounce samples were purchased; these ranged in price from 25 to 50 cents. In the two cases where one ounce was asked for the prices were 50 and 75 cents.

TABLE XLV.—ANALYSES OF PANCREATIN.

Sample Number.	Color and appearance.	Cost of material.	Weight of material. Claimed.	Weight of material. Found.	Insoluble in Water.	Amylolytic Power. U. S. P. test. 0.3 gm. pancreatin. Starch taken.	Water taken.	Test with Iodine.	Starch digested times weight of pancreatin	Proteolytic Power. Coagulable Protein in residue by U. S. P. test.	Coagulation with acetic acid after digestion in U. S. P. test. 5.6 mgms. pancreatin, 247.2 mgms. milk casein taken. Casein undigested.	Casein digested.	Casein digested times weight of pancreatin.
		cts.	gms.	gms	%	gms.	cc.				mgms	mgms.	
3148	Yellow-white powder	25	15.5	12	*21.6	7.5	120	No color	+25	Yes	221.4	25.8	4.6
3672	Cream-white powder	75	15.5	12	15.9	2.1	34	Slight purple	− 7	"	175.5	71.7	12.8
3137	Yellow-white powder	40	15.5	12	14.9	5.4	86	No color	+18	"	143.6	103.6	18.5
3201	Yellow-white powder	50	31.0	16	16.9	7.5	120	No color	+25	"	181.8	65.4	11.7
3047	Yellow-white powder	75	31.0	30	17.7	3.9	62	No color	+13	"	185.7	61.5	11.0
3675	Cream-white powder	30	15.5	16	20.5	7.5	120	No color	+25	"	143 6	103.6	18.5
2307	Yellow-white lumps	35	15.5	14	21.6	7.5	120	Faint purple	−25	"	176.1	71.1	12.6
3203	Dirty-yellow lumps	30	15.5	15	34.0	7.5	120	Faint purple	−25	"	181.8	65.4	11.7
3086	Yellow-white powder	25	15.5	15	*11.1	5.4	86	No color	+18	"	215.6	31.6	5.6
3174	Yellow-white lumps	35	15.5	13	7.1	5.4	86	No color	+18	"	146.7	100.5	18.0
3676	Cream-white powder	50	15.5	11	26.5	5.4	86	Faint blue	−18	"	171.0	76.2	13.6
3674	Yellow-white lumps	40	15.5	15	10.0	2.7	43	No color	+ 9	"	147.4	99.8	17.8
3111	Deep-yellow powder	40	15.5	16	*71.5	0.3	5	Green-blue	0	"	233.5	13.7	2.3

* Contained reducing sugar.

Weight Claimed and Weight Found. Six of the samples slightly exceeded or approximately equaled the weights claimed. The other samples showed deficiencies of from 1.5 to 15 grams, or from 10 to 50 per cent. of the claimed weight. The only original package received with seal unbroken satisfied the claimed weight. The responsibility for the shortage in weight would seem to rest, in these particular samples at least, with the dispenser and not the manufacturer.

Insoluble in Water. The insolubility ranged from 7.1 to 71.5. One sample was superior to the U. S. P. requirement of "not more than 10 per cent.," one exactly equaled it, and another slightly exceeded it. The other ten samples exceeded the limit by from 50 to 600 per cent. No. **23111** showed the exceedingly high insolubility of 71.5 per cent.

Amylolytic Power. Under the conditions of the U. S. P. test, some of the samples converted over twenty-five times their weight of starch into water-soluble substances (dextrin and maltose) and others none at all. No. **23111** showed no amylo-

lytic power whatever. Five samples exceeded or nearly equaled the U. S. P. strength, four showed a deficiency of about 25 per cent., one a deficiency of about 50 per cent., and two deficiencies of about 65 per cent.

Proteolytic Power, U. S. P. Test. Under the conditions of the U. S. P. test all the samples showed coagulation, indicating that the casein had in no case been completely peptonized.

Proteolytic Power, Acetic Acid Test. Of the 247.2 mgms. of milk casein employed in each test, only 13.7 to 103.6 mgms. were digested, or in other words the pancreatin digested only from 2.3 to 18.5 times its weight of milk casein, as compared with forty-four times, as required by the U. S. P. One of the samples, No. **23675**, showing high amylolytic power, also showed the highest proteolytic power. On the other hand, No. **23148**, of high amylolytic power, was next to the lowest in proteolytic power. No. **23111** showed the lowest proteolytic power, holding the same low rank it did in all the other tests, and showing it to be practically valueless as an enzymatic agent.

Summary.

Of the thirteen samples examined, eight satisfied the U. S. P. standard for color and appearance. Three satisfied the standard for insoluble matter. Five samples showed the required amylolytic power and none the required proteolytic power. None of the thirteen samples satisfied all the requirements of the U. S. P.

Methods of Analysis.

The following methods of analysis were used:

Insoluble in Water. Treat 0.3 gm. of material with 10 c.c. of water (40° C.) in a test tube, and heat for fifteen minutes in a water bath at the same temperature, with frequent agitation to break up the lumps and facilitate solution. Wash on to a tared filter paper with water (40° C.) and continue the washing with small quantities of water at a time at this temperature until 100 c.c of filtrate have passed through. Dry the filter and insoluble material in a water oven at 100° C. to constant weight. An effort to use Gooch crucibles with suction failed because of clogging of the filter.

Amylolytic Power. It was our desire to ascertain not only whether the different samples were up to standard, but, if below, how great was the deficiency. Repeated tests were made, therefore, on all the samples, using varying amounts of starch and water, but always in the same relative amounts. The amount of pancreatin used was constant, 0.3 gm., in all the

experiments. In this way a close approximation to the amylolytic power of the pancreatin may be obtained. It was observed that the color of the solution increased after a few minutes, e.g., a pink developed into a pronounced violet or purple. "No color" in the table means that no color, even pink, was produced by the addition of two drops of the converted starch solution.

Table XLVI shows all the tests made on the different samples and gives the data on which our judgment as to their starch-converting power was based. For convenience the quantity of starch taken was always a multiple of 0.3 gm., the amount of pancreatin used in all the tests.

TABLE XLVI.—STARCH-DIGESTING POWER USING EQUAL AMOUNTS (0.3 GM.) OF PANCREATIN AND VARYING AMOUNTS OF STARCH AND WATER.

No.	Starch.	Color.	No.	Starch.	Color.	No.	Starch.	Color.
	gms.			gms.			gms.	
23148	7.5	none	23047	7.5	blue	23086	7.5	blue
23672	7.5	blue		6.0	blue		6.0	blue
	6.0	blue		4.5	blue		5.7	blue
	4.5	blue		3.9	none		5.4	none
	2.4	blue		3.6	none		4.8	none
	2.1	faint blue		3.3	none		4.5	none
	1.5	none	23676	6.0	faint blue	23174	7.5	blue
23137	7.5	blue		5.4	very faint blue		6.0	blue
	6.0	blue		5.4	none		5.7	blue
	5.7	blue	22307	7.5	very faint purple		5.4	none
	5.4	none		6.0	faint pink	23675	7.5	none
	4.5	none		4.5	faint pink		6.0	none
23201	7.5	none		3.0	faint pink	23674	6.0	blue
	7.5	very faint blue	23203	7.5	very faint purple		3.0	faint blue
	6.0	none		6.0	none		2.7	none
23111	0.3	blue		4.8	none		2.1	none
	0.3	blue						

Proteolytic Power, U. S. P. Method. Weigh 0.28 gm. of pancreatin and 1.5 gm. of sodium bicarbonate, and dissolve the two together in 100 c.c. of water at 40° C. Heat 400 c.c. of fresh cow's milk to 38° C., and add the solution above prepared to it, and allow to stand in a water bath at 38° C. for thirty minutes. Remove from the bath and pipette 10 c.c. into a test tube, and add three drops of concentrated nitric acid and shake; the appearance of no coagulation indicates that the milk has been completely peptonized.

The U. S. P. method is indefinite as to the amounts of the peptonized milk and nitric acid to be used. After several trials we found the quantities stated above to be satisfactory.

Proteolytic Power, Acetic Acid Method. As all of the samples showed decided coagulation by the U. S. P. test, we desired to determine their relative proteolytic power. Nitric acid being naturally excluded because of its nitrogen content, acetic acid was employed in the following way:

The preliminary treatment of the milk with the pancreatin was exactly the same as in the U. S. P. test. 10 c.c. of the peptonized milk was pipetted into a test tube and 0.5 c.c. of acetic acid (1:3) added, and the contents after shaking were heated to incipient boiling, and filtered and thoroughly washed with cold water. The filter papers and residues were then transferred to Kjeldahl flasks and nitrogen determined, proper correction being made for the nitrogen of the paper. This insoluble residue represented the milk casein not peptonized by the pancreatin.

The milk used contained 3.00 per cent. of casein, and the 8 c.c. used in the test contained therefore 247.2 mgms. of casein.

The question was raised whether a portion of this insoluhle nitrogen might not be due to the pancreatin itself. To determine this point, tests were made in every sample exactly as before, except that 400 c.c. of water was used instead of the milk. The greatest amount of nitrogen found in any case was 0.02 mgm., a negligible quantity, and in eight of the thirteen samples none was found.

Starch and Reducing Sugar. The filtrates from the determination of water-insoluble material were tested for starch and reducing sugars.

SUGAR OF MILK.

(*Saccharum Lactis.*)

Forty-eight samples were examined; all of these showed almost complete purity by the polariscope.

The U. S. P. requires that the percentage of ash should not exceed 0.25 per cent. In most of the samples examined the ash was very low, ranging from 0.018 to 0.230 per cent. In four samples, however, the U. S. P. limit was exceeded, and percentages of 0.274, 0.30, 0.32 and 0.72 were found. In these samples lime was found to the amount of from 0.095 to 0.236 per cent.

The samples were generally true to weight, but the selling prices of the same quantity, 4 oz., ranged from 10 to 20 cents.

MISCELLANEOUS DRUGS.

(*Spirit of Peppermint.*)

23297. Arthur's Pure Spirits Peppermint, U. S. P. The Arthur Chemical Co., New Haven. Price, 10 cents for 1.1 oz. It contained 11.60 per cent. oil of peppermint by volume and was free from artificial color. It was up to standard.

23040. Social Brand U. S. P. Pure Ess. Peppermint. Edward D. Depew & Co., New York. Price, 10 cents for 1.4 oz. It contained 5.80 per cent. oil of peppermint by volume and was free from artificial color. It was only 58 per cent. U. S. P. strength.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Twelve samples were tested for fat, all of which satisfied the legal standard.

Skimmed Milk. The single sample tested contained 0.05 per cent. of fat.

Cream. Fifty-one samples were tested; they ranged from 10.25 to 41.92 per cent. of fat; fourteen contained less than 16 per cent.

Vinegar. Fifteen samples were tested, eight of which satisfied the legal standard; the other seven were low in acidity or solids or both.

Root Beer. Two samples were tested for alcohol; they contained 1.14 and 0.57 per cent. by volume.

Wheat Flour and Biscuit. A sample of wheat flour contained 18.61 per cent. arsenious oxide; a biscuit supposedly made from this flour contained 0.988 per cent. of arsenious oxide. It is supposed that the arsenic was added to the flour in the form of "Rough on Rats" with criminal intent.

Rye Flour. Two samples damaged by smoke and water were submitted. Both were condemned as unfit for human use.

Whiskey. Two samples were tested for wood alcohol with negative results.

African Ginger. The sample tested was found to conform with the standard.

Coffee. A sample of ground coffee was found to be adulterated with chicory.

Granulated Sugar. The two samples examined were found to be pure sugar.

Butter. Five samples were examined; all were found to be pure, except for an excess of water in one case.

Condensed Milk. A sample of Van Camp's Condensed Milk contained 8.41 per cent. of fat, and was fully up to standard in this particular.

Mace. Two samples of compound mace were tested with the following results:

	23925	23926
Ether extract	23.19	25.96
Non-volatile ether extract	20.02	22.54
Total ash	2.03	1.99
Ash insoluble in HCl.	0.25	0.18

Wine. A sample of local manufacture showed specific gravity at 15.5°, 1.0727, and 8.49 per cent. alcohol by weight, or 10.55 per cent. by volume.

Linseed Oil. No adulteration was detected in the two samples examined.

India Relish. The sample examined contained no sodium benzoate.

Water from Boiled Corned Beef. The sample examined contained no saltpeter.

Bismuth Subcarbonate. The sample contained 88.92 per cent. of bismuth oxide, and traces of iron. No arsenic, lead or copper was present. It was slightly below U. S. P. strength.

Jamaica Ginger. The sample analyzed as follows: specific gravity at 15.5° C., 0.8238; alcohol by volume, 95.18; wood alcohol, none; total solids, 0.79; solids soluble in alcohol, 0.79; solids soluble in water, 0.21 per cent. The total solids are rather low for pure Jamaica ginger, and the solids soluble in water are relatively high. Sugar was absent.

Medicines. Twenty-six samples of various medicines were submitted by a New Haven detective, as the product of a firm of physicians temporarily practicing in New Haven among the poorer class of Italians. The samples were small and only partial analyses were made, the details of which will not be given here. Two samples contained morphine in considerable quantity.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1910.

The following samples were referred to this station by the dairy commissioner for examination:

Butter and Butter Substitutes. Of the fifty samples examined six were adulterated, and forty-four were oleomargarine, renovated butter or materials required to pay the oleomargarine tax by the Internal Revenue Department. In many cases the illegality of the samples consisted in the failure to display the required sign when selling oleomargarine, or failure to stamp renovated butter at the time of sale.

Milk. Of the fifty-four samples examined, thirty-six satisfied the legal standard. Of the delinquent samples, two were skimmed and fourteen were watered.

Molasses. No adulteration was found in any of the two hundred and twenty-one samples examined, although in a few samples the water content slightly exceeded the standard of 25 per cent.

Vinegar. Two hundred and sixty-four samples were examined, of which fifty-six failed to meet the legal standard or were sold illegally.

Flavoring Extracts. Five lemon, four peppermint, four vanilla, two orange, one wintergreen, and two ginger extracts were examined. One lemon extract was pure, three adulterated and one compound; both peppermint extracts were adulterated; two vanilla extracts were pure, one adulterated and one compound; both orange extracts, the wintergreen extract and both ginger extracts were adulterated.

Lard. The sample examined was adulterated with cottonseed oil.

Jam. A sample of raspberry jam was a legally labeled compound. A sample of "Pineapple Chunks" was found free of preservatives and artificial color.

Ketchup. The sample examined was adulterated, containing 0.24 per cent. sodium benzoate, which was not declared on the label.

Ice Cream. Three samples of vanilla ice cream contained 8.80, 9.15 and 9.79 per cent. of butter fat.

Catarrh Remedies. Eight samples were examined, all of which contained a salt of cocaine, thus rendering their sale illegal, except on a physician's prescription.

Spirit of Camphor. Nine samples were examined, only three satisfying the U. S. P. standard.

Hydrogen Dioxide. The sample contained acetanilide, which was not declared on the label.

Cough Medicine. Two samples marked "Cough Medicine" and one marked "Liniment" were submitted. One of the cough medicines was found to be identical with the liniment. This careless error in labeling of the New Britain druggist made a child, who took the medicine, violently ill and threatened its life. The preparation contained 2.70 per cent. ammonia, camphor, opium and 75 per cent. of alcohol.

Oakite. A cleansing powder. Its alkalinity was equivalent to 7.3 cc. normal sodium carbonate per gram. Carbonates and borates were present.

TABLE XLVII.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1910.

	*Not found Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Almond Extract	8	6	--	14
Banana Extract	--	1	1	2
Bouillon	6	--	--	6
Canned Peas	--	--	--	111
Cerena	--	--	--	1
Ginger Extract	7	20	7	34
Gluten Preparations	--	--	--	5
Ice Cream Cones	22	5	--	27
Ketchup	5	52	17	74
Mince Meat	17	1	1	19
Orange Extract	13	7	--	20
Peppermint Extract	4	6	3	13
Pineapple Extract	--	3	10	13
Raspberry Extract	1	3	3	7
Strawberry Extract	--	6	9	15
Tomato Soup	12	--	--	12
Wintergreen Extract	6	5	--	11
Alcohol	5	65	--	70
Diluted Alcohol	--	1	--	1
Bismuth Subnitrate	25	--	--	25
Formaldehyde	8	3	--	11
Fowler's Solution	25	30	--	55
Tincture of Ginger	12	2	--	14
Olive Oil	64	10	--	74
Pancreatin	--	13	--	13
Spirit of Camphor	54	15	--	69
Spirit of Peppermint	1	1	--	2
Sugar of Milk	44	4	--	48
Total	339	259	51	766
Sampled by Dairy Commissioner.				
Butter and Butter Substitutes	6	44	--	50
Ginger Extract	--	2	--	2
Jam or Preserves	1	--	1	2
Ketchup	--	1	--	1
Ice Cream	--	--	--	3
Lard	--	1	--	1
Lemon Extract	1	3	1	5
Milk	36	18	--	54
Molasses	221	--	--	221
Orange Extract	--	2	--	2
Peppermint Extract	--	4	--	4
Vanilla Extract	2	1	1	4
Vinegar	208	56	--	264
Wintergreen Extract	--	1	--	1

* Also includes misbranding.

TABLE XLVII.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1910—*Continued.*

	*Not found Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Dairy Commissioner.				
Spirit of Camphor	3	6	--	9
Catarrh Remedies	--	8	--	8
Cough Medicine	--	--	--	2
Hydrogen Dioxide	--	1	--	1
Liniment	--	--	--	1
Oakite	--	--	--	1
Total	478	148	3	636
Sampled by Private Individuals.				
Bismuth Subcarbonate	1	--	--	1
Biscuit	--	1	--	1
Butter	4	1	--	5
Coffee	--	1	--	1
Condensed Milk	1	--	--	1
Corned Beef Liquor	--	--	--	1
Cream	37	14	--	51
Diabetic Bread	--	--	--	1
Ginger	1	--	--	1
Ginger Extract	1	--	--	1
India Relish	1	--	--	1
Linseed Oil	2	--	--	2
Mace	--	--	2	2
Medicines	--	--	--	26
Milk	12	--	--	12
Skimmed Milk	--	--	--	1
Root Beer	--	--	--	2
Rye Flour	--	2	--	2
Granulated Sugar	2	--	--	2
Vinegar	8	7	--	15
Wheat Flour	--	1	--	1
Whiskey	--	--	--	2
Wine	--	--	--	1
Total	70	27	2	133
Total from all sources	887	434	56	1535

* Also includes misbranding.

PART VII.

TESTS OF SUMMER SPRAYS ON APPLES AND PEACHES IN 1910.

BY G. P. CLINTON, S. D., *Botanist*, and
W. E. BRITTON, PH.D., *Entomologist.*

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Introduction. With the exception of some experiments early in the history of the Station by Thaxter, the first botanist, on pear and quince for scab and leaf blight troubles, later work by his successor, Sturgis, on peaches for scab and rot, and still more recent work by Britton in summer spraying of peaches for San José scale and by Walden, for the sawfly,—the spraying work undertaken by the Station on fruit trees has been confined chiefly to treatments of the dormant trees, largely to destroy the San José scale. The prominence that the peach industry has attained in the State, and the serious injury that results from scab and rot, hitherto uncombated, together with the revival of interest in apple growing and the recent advocacy of new summer sprays to supplant the standard Bordeaux Mixture, all combine to make necessary further experiments with summer sprays.

With these considerations in view, work was begun the past season with our two most important fruit trees, the apple and peach. Previous experimentation, in various states, has largely determined when and how often it is necessary to spray for each particular trouble of these fruit trees; so, taking advantage of this knowledge, the work has been chiefly the testing of new sprays as regards their fungicidal value as compared with those previously used, and especially with reference to avoiding spray injury, so frequently produced under the older methods.

This report includes the summarized results of the single season's work. The details of the counts and observations made in each orchard being very voluminous cannot be given within the limits prescribed by law for our report. The work involved the careful counting, examining and recording of some 60,000 individual apples and 25,000 peaches. Of course these results will prove of permanent value only as subsequent tests under the varying seasonal and other conditions verify them. In the main, however, there seems to be no reason to doubt their general application, especially since the results of recent experiments by others are largely in accord with them. It is expected, however, that at least another season's test will be made of those treatments which have shown the most value the past season.

SPRAYING EXPERIMENTS WITH APPLES.

Details of Experimentation.

Object. Because of serious injury in this State, especially in 1909, from the use of Bordeaux Mixture, which caused spotting and premature fall of the foliage and russeting of the fruit, and because of the introduction of commercial lime and sulphur preparations as summer sprays and repeated requests for information concerning them, the Station undertook last season extended experiments looking into these subjects. No better fungicide than Bordeaux Mixture is known. It has long been the one most generally used to combat fungous attacks on a great variety of plants, and has given uniformly better results than any other, with no injury resulting from its use in most cases. But with apples under certain weather conditions, injury sometimes results that outbalances its benefits as a fungicide.

The question, therefore, is not a better fungicide for apples than Bordeaux, but one of equal or nearly equal merits that will not produce these occasional injuries. Another question connected with this is whether or not all the russeting of the fruit is caused by the Bordeaux or whether part of it is due to certain seasonal conditions such as late frost.

Orchards under Experimentation. The results of spraying, aside from the kind of spray used, depend upon the varieties experimented with, their previous treatment with spray mixtures, and the character of the season. Simple as it may seem, it is rather difficult to obtain all of these conditions favorable for a test. For example, this season as a whole was not favorable for fungous attack, so there is not as great a difference shown between our sprayed and unsprayed apples in this respect as there would have been with a different season. Again, Baldwin, Greening and Russet apples are perhaps the standard varieties grown in the State, and as such were the ones chiefly experimented with; but they are not nearly so susceptible to attack from the scab fungus as are the McIntosh, Fameuse, and certain other varieties which are also grown here more or less, but which unfortunately were not available in the orchards under experiment. At least two of the orchards had been thoroughly sprayed in the past, both for fungi and for insects, and these showed less difference between the sprayed and unsprayed trees this year than the orchards not previously sprayed.

Seven orchards in different parts of the State were used in the work, and they included trees varying in size from those just set out to very large ones, perhaps fifty years old. The owners and localities are as follows: E. M. Ives, Meriden; B. T. Jones, Centerville; E. Rogers, Southington; S. A. Smith, Cheshire; C. H. Savage, Storrs; J. E. Stoddard, Abington; Experiment Station (Webb orchard), Centerville. The Station is under obligation to those who thus placed their orchards at its disposal and helped the work in other ways and to Prof. C. D. Jarvis of the Connecticut Agricultural College for his cordial coöperation in placing under our direction several of the orchards where he was doing demonstration work in connection with the Connecticut Pomological Society. Credit is also due to E. M. Stoddard, assistant in botany, and to B. H. Walden and A. B.

Champlain, assistants in entomology, for help in conducting the experiments.

Altogether about 350 trees were sprayed from two to four times (including the winter treatments), and at least seventy-five others were reserved for checks. The counts at the end of the season were made from only part of these trees. The varieties used were chiefly Baldwin, Russet, Greening and Pound Sweet, but besides these there were occasional trees of Hurlburt, Gravenstein, Jonathan, King, Yellow Transparent, Hubbardston, etc.

Treatment. As Bordeaux Mixture is the fungicide almost universally used in this State, and as it was the one to be replaced if possible, we used it in every one of the orchards, for comparison with the other fungicides as well as with the check unsprayed trees. Ordinarily the Bordeaux used is the 4-4-50 formula, that is, 4 lbs. copper sulphate, 4 lbs. lime, and 50 gallons of water. This was used in the different experiments, and varied to 3-4-50, 2-4-50, and even 1-4-50 strengths by using less copper sulphate, which is the chemical furnishing the fungicidal value (copper hydroxide) and at the same time the injurious substance of the spray.

The second type of mixtures tried was the commercial lime and sulphurs that have been used for some time on dormant trees for the San José scale, but have only recently claimed attention as summer sprays of fungicidal value when used in weaker solutions. On the dormant trees these are ordinarily used at strengths of from 1 to 12 up to 1 to 8. In our winter treatments we used one of these at a strength of 1 to 9, and in our summer spraying we used them in strengths of 1 to 50, 1¼ to 50, and 1½ to 50, the lower strength being about the limit of usefulness, and the higher near the danger point of injury to the foliage, as stated by previous investigators. The commercial lime and sulphur sprays have for their fungicidal agent sulphides of lime, produced by chemical action (under heat) of the lime and sulphur used in their preparation. The preparation is a clear amber-colored liquid, very easily mixed with water, and very convenient and easy for spraying. Some few manufacturers, as in the case of the Niagara lime and sulphur, add an excess of lime as a sediment, to protect against injury to the fruit and foliage by burning. So far as we could judge by general appearances, the

different brands used in the tests were of the same quality, and specific gravity tests of the three used at the Smith farm showed them to be about the same strength. The brands used in the experiments were Grasselli, Blanchard, Sherwin-Williams, and Niagara.

The third type of sprays used were those commercial preparations having beside lime and sulphur some other ingredient or ingredients in their make-up. Of this type the three brands used were "Sulfocide," "Bogart's Sulphur Compound," and "One for All." None of these were used to the extent that the straight commercial lime and sulphur brands were used, because there seems to be more danger of burning the foliage with them. "Sulfocide" contains as one of its ingredients some caustic soda, nd this, if neutralized in its manufacture, probably produces no arm, but if not all neutralized, it is liable to burn the foliage. ikewise, when either Paris green or arsenate of lead is added, ome soluble arsenate is formed which is quite injurious to the oliage. Bogart's "Sulphur Compound," according to the manuacturer, "is composed of pure brimstone sulphur reduced to a oluble form; the only other ingredients in the compound are uch vegetable oils as to produce a sticky spray." If caustic soda s used at all to dissolve sulphur, it might explain the injury aused by this preparation when used with arsenate of lead. One for All" is a paste of the color of mustard and water, and ontains wool grease, lime, sulphur and arsenic. The manufacurers claim it to be a fungicide, and both an arsenical and a conact poison for insects. In our tests it was diluted according to irections at the rate of 6 and 5 lbs. of the paste to 50 gallons r one barrel of water.

The fourth type of sprays tested was self-boiled lime and sulhur. This is a homemade mixture in which the heat of the laking lime is used to dissolve a small amount of sulphur, formg sulphides of lime. We used the formula 8-8-50, recommended y Scott, of the U. S. Department of Agriculture, and made it fter his directions, as follows: Eight pounds of lime were laked with a small amount of water in a barrel, and when thorughly heated, 8 lbs. of flowers of sulphur were sifted and horoughly stirred in, making a moderately thin paste, which as allowed to heat for fifteen minutes, and then was diluted ith water to 50 gallons. The mixture was thoroughly stirred

and then strained through ordinary wire strainers into the spray barrel. This mixture is rather more cumbersome to make than Bordeaux, and, having more sediment, clogs the spraying apparatus more easily.

In all of the above spray mixtures, except "Sulfocide," arsenate of lead was used as the insecticide, being added to the spray mixture in paste form at the rate of 3 lbs. to 50 gallons, or to the barrel. In some cases, however, the poison was omitted for the first spraying (before blossoming), and in the last (fourth or fifth) spraying, as the important applications of poisons are those two made first after the blossoming period.

For the apple it has been found by previous experiments that from two to four summer treatments are necessary to control the different fungous pests, and insects may be controlled at the same time by the addition of poison to the fungicide. Ordinarily these treatments were as follows: (1) On the young unfolding leaves just before the blossoms open; (2) on the leaves just after the petals fall; (3) about two weeks later, or on the very young fruit; (4) three or four weeks later on the small fruit. This year, being a season when blossoms started early, and then held back over a longer period than usual, the summer sprayings were made at the various orchards between the following dates: (1) April 27th to May 1st; (2) May 10th to 20th; (3) June 3d to 18th; (4) July 7th to 19th. The second and third sprayings were made in all the orchards, as the most desirable where only two could be made, especially as regards insects, while the first spraying was omitted in five of the orchards, and the fourth in four. No orchard received all four treatments. Most of the orchards, however, had been given a winter treatment for San José scale by their owners. Plates XVII, XVIII.

Collecting Data. At each spraying the trees were examined in a general way for injury to the leaves or fruit from the previous treatment and for fungi and insects; but the specific conclusions were based on inspection of the fruit at harvest time. As far as possible the fruit was examined when picked. Some of the sprayed trees bore little or no fruit, and in other cases it was not found necessary to make counts of all trees which had the same treatment in the same orchard. When only a small number of apples were borne, all of them were included in the counts,

but where the crop was large, usually only five hundred to one thousand were counted for each tree. In the latter case we aimed to get these from different parts of the tree, but otherwise to take them as they came.

In collecting the data no attention was paid to the comparative yield of the sprayed and the unsprayed trees; because the trees in the different orchards varied considerably in the amount of bloom and consequently in the amount of fruit set; but unless trees are of the same variety and bloom the same, it is impossible to tell whether or not any difference in yield is due to the spraying. Likewise, one has to be very cautious in comparing with each other trees that are of different varieties or in different orchards. There is also a difference in results whether one counts only picked apples or includes the windfalls also. Except in two cases, the Jones and Savage orchards, the apples did not include any windfalls.

Altogether about 60,000 apples were individually examined and records made of each, whether or not it was perfect, russeted or attacked by fungi or insects, aud in case of fungous or insect injury, the kinds were noted. From these numbers the percentages of each were worked out, based on the whole number of apples examined from that tree. These percentages usually foot up a little more than 100, since occasionally an apple had to be counted twice or rarely even three times, because of the presence of two or three troubles. The most common duplicates were codling moth and rot, or russet with some fungous or insect trouble. In order to give a better understanding of the fungous and insect pests, brief descriptions are here given of those present in the orchards examined, which include the ones most injurious in the State.

Fungous Diseases.

Baldwin Spot. While we have included this with the fungous troubles, it is certainly not such, since each year for several years we have tried to obtain cultures from these spots in the fruit, and have uniformly failed. It is a physiological disease, but its cause is not known, though attributed to a variety of things. From observations that have been made in Mr. Ives's orchard there are some grounds for the belief that possibly it may be due to the Rosy Apple Aphis, which occurs on the young fruit,

and on certain trees, more abundantly in some seasons than in others. The Baldwin spots show as small collapsed masses of brownish tissue, usually a short distance beneath the skin, and these may finally appear at the surface as small sunken areas. While the Baldwin is the most susceptible variety, it is not the only one having this trouble, which usually shows on the apples late in the season and in storage. Certain of the fruit speck troubles, due to fungi, are very similar in appearance and are hard to distinguish in the field when the apples are not cut open, so that these two troubles as they appear in our tables are only superficial determinations. No remedy is known for the Baldwin spot. Plate XXI, a.

Black Rot, Sphæropsis malorum. This fungus causes cankers on the larger branches, kills the twigs, produces the common small brown spots that so often pepper the apple leaves in early summer, besides rotting the fruit. With the summer varieties and in stored apples it causes a brown rot that finally turns black, hence the common name. The ordinary winter apples and hardier fall apples do not usually suffer from this trouble, except through insect injuries or in the form of fruit speck troubles that do not develop as true rots until after some time in storage. As this trouble often develops on the leaves most conspicuously under infected branches, the remedy is to keep the trees pruned of all dead wood, and if there are cankers, to have these cut out and painted over. Likewise, any fungicide applied during the early part of the season is helpful, though it is difficult to entirely prevent the spotting of the foliage by spraying alone. The use of insecticides, also, in keeping out codling moth, lessens the rot starting from this cause. Plate XXI, b.

Fruit Spot, Cylindrosporium pomi. This is a fungus that causes more or less numerous small specks extending only slightly beneath the skin, usually showing late in the summer, and it is most common in our experience on seedling apples, especially those with a light-colored skin, where it may usually be distinguished by the purplish-colored spots much like those caused by the San José scale. The fungus does not seem to fruit on these spots, and so has been overlooked by us as a fungous trouble until this season. Besides this fruit speck there

is that mentioned above, caused by the black rot fungus, and a species of Alternaria is apparently responsible for another. All these are common in storage apples, and are more difficult to distinguish by the naked eye. Late treatments with fungicides decrease these troubles, and so where they are prevalent the fourth treatment mentioned above is of value. Plate XXI, c.

Rust, Rœstelia pyrata. This is the rust ordinarily found on apples here, though another very closely related species sometimes occurs. It infects the leaves most abundantly, but the fruit is also attacked. On the upper side of the leaves it forms bright orange-colored spots, appearing usually in June or July, and in the spots are small black specks, producing spore-like bodies whose function is unknown. On the under surface of the leaves in these spots there later appears the true spore stage in the shape of a cluster of short hair-like projections that on maturity become converted into fringed and recurved cup-like receptacles containing an orange-colored mass of spores. These spores do not spread the disease further on the apple, but carry it to the red cedar, and form eventually the "cedar apples" that in the spring produce jelly-like horns from these galls in which another spore stage is formed, which on germination carries the disease back to the apple. There is a great difference in the susceptibility of different varieties to attack by this fungus, among those most susceptible being the Wealthy, Fallawater, Hurlburt, Jonathan, King and Russet. The Baldwin and Greening are not very susceptible. The fruit, especially when of a resistant variety, often produces when attacked only the imperfect stage. Of course the presence of cedars in the vicinity of the orchard favors the development of this fungus, but apparently the spores can be carried from some distance and still infect an orchard considerably. Spraying has to be done thoroughly and repeatedly in order to do much good, so that the four treatments mentioned previously are apparently required. Plate XXI, d.

Scab, Fusicladium dendriticum. This fungus is recognized on the fruit by the small, scabby, olive-black outbreaks it produces in the skin, and if abundant enough, often causes distortion and stunting, as the infection takes place when the fruit is quite young. The fungus also occurs on the leaves, producing radiat-

ing olive-black superficial growths in spots on either surface, which if abundant, cause premature shedding in the fall. It occurs less frequently on the young twigs. Its mature stage forms in the spring on the old leaves of the previous year, and re-infection takes place from these or from the parasitic stage carrying over on the twigs. As with the rust, wet, cold springs are very favorable for the development of this fungus. There is considerable difference in varietal resistance to it, such summer and fall varieties as Early Harvest, Fall Pippin, Fameuse, and McIntosh being most susceptible, apparently in part because the fungus winters over in the twigs. This is the fungus that started the work with fungicides on apples in this country, and is generally considered the worst fungous pest of the orchard. On the whole we do not believe it so serious in tbis State as in many other regions, partly because the Baldwin, Greening and Russet apples are not so subject to its attacks. The first three treatments previously mentioned are the ones usually given for this trouble, and where Bordeaux has been used, have given very satisfactory results so far as controlling the fungus is concerned. Plate XXI, e.

Sooty Blotch, Phyllachora pomigena. This fungus causes a superficial black spotting of the surface of the apples without especial injury to the skin, so that the fungus may be largely removed by a vigorous polishing. This superficial growth consists of the mycelium or vegetative stage, certain cells of which apparently function as spores. The flyspeck fungus, so named from its appearance, is often associated with it, and is regarded by some botanists as not distinct. The chief injury caused by this fungus is due to the untidy appearance it gives the infested apples, and in this respect it is a serious drawback. Just what the life history of the fungus is has not been clearly worked out, but apparently it passes over the winter on the twigs in some way, and probably matures on the fallen rotten fruit. The fungus is most conspicuous on light-colored fall and winter apples, especially on neglected seedlings. The Greening is often seriously affected by it. During dry seasons this fungus is not conspicuous, but in wet ones, especially those wet in late summer and early fall, it becomes one of the most, if not the most, injurious apple fungus of the State. Where orchards are thor-

oughly sprayed each year, especially where the fourth, or latest application is included, this fungus does comparatively little harm unless the season is exceptionally bad. Plate XXI, f.

Other Rots. Besides the preceding, on some of the summer varieties and on apples in storage there occur a few other fungi that cause rot, but they are not easily differentiated from one another, and are not so important commercially as those mentioned above. There are also a few leaf or branch fungi found here of more or less economic importance that are not included in the above list.

Insect Injuries.

Apple Maggot or Railroad Worm, Rhagoletis pomonella Walsh. A small maggot injures the fruit by tunneling in the flesh, and decay soon follows. The adult is a small two-winged fly, with wings conspicuously marked with four black cross bands. The egg is laid just beneath the skin, hatches in a few days, and the larva when full grown emerges from the fallen fruit and pupates in the ground. Probably there is only one brood each season, and the late insects develop after the fruit is stored, if the temperature is not too low. The pest is much worse in soft and non-acid varieties. As the maggot is beneath the skin, it is out of the reach of sprays, and destruction of fallen fruit and surface cultivation of the orchard are the remedies. Pasturing with hogs or with sheep is also effective. Though no form of spraying can be recommended against this insect, the orchards which have been carefully sprayed are often less affected. Plant late varieties having a firm flesh and acid flavor. Plate XXIV, a.

Bud Moth, Tmetocera ocellana Schiff. This insect often ruins the apple crop by attacking the cluster buds and eating out the undeveloped flowers. There is probably but one brood each season in Connecticut, and the half-grown caterpillar passes the winter in a silken case attached to the twigs. In early spring the caterpillars feed on the opening buds, curling and fastening together the young leaves, as is shown on Plate XXIV, j. They reach full size in June, and are light chestnut brown in color with head, legs and thoracic shield shiny dark brown or black. The cocoon is formed in the dead leaves, and a short time afterward the adult appears as a gray moth, with a wing-spread of

about five-eighths of an inch and with broad yellowish cross bands on the forewings. Thorough spraying with lead arsenate is the remedy, and at least one application should be made before the blossoms open.

Canker Worms, Alsophila pometaria Harris (fall canker worm), and *Paleacrita vernata* Peck (spring canker worm). Canker worms feed upon the young leaves in May, often entirely defoliating orchards in different sections of the State. Most of the damage is done here by the fall species, which emerges from the ground and lays eggs during the warm days of November and December. The spring canker worm lays eggs in March and April. The eggs of both species hatch late in April or early in May, and the young caterpillars eat small holes through the leaves or devour all of the green tissue, leaving only the large veins. Later, as the leaves become larger and tougher, the worms often leave the network, which turns brown in June and looks as if a fire had gone through the orchard. The caterpillars loop when they crawl, and vary from leaf-green to nearly black in color, but are marked lengthwise with fine whitish lines. They are usually through feeding and go into the ground to pupate during the first week in June, the adult moths appearing the following autumn, or, in case of the spring species, the next spring. Both sexes are gray, with indistinct markings. The female is wingless and must crawl up the trunks of the trees, and may be kept off by the use of sticky bands, as described in the Report of this Station for 1907-1908, page 792. In orchards where spraying is practiced no other method need be considered, as the pest can be controlled by the use of arsenical poisons.

Codling Moth or Apple Worm, Carpocapsa pomonella Linn. This is probably the most important insect attacking the fruit of the apple in Connecticut. The adult is a brown moth with a wing-spread of about three-fourths of an inch, and lays eggs on the leaves or young fruit soon after the fruit sets. The young larvæ feed on the leaves or fruit, and burrow into the latter, usually entering through the calyx cavity and working in around the core. When nearly full grown, late in July, it eats its way out of the apple, leaving a large hole. It is then nearly three-fourths of an inch long, and of a pinkish or flesh color. The

cocoons are formed under loose bark or under rubbish around the tree, and in this stage most of the insects pass the winter; some of the early ones, however, emerge and lay eggs for the second brood, which is probably not extensive in Connecticut. The proper treatment is to spray with arsenical poison soon after the blossoms fall, and again about a month later. Plate XXIV, i.

Curculio (see under Peach, page 609).

Lesser Apple Worm, Enarmonia prunivora Walsh. The larva of a small moth often feeds on the surface of the nearly mature fruit in the manner shown on Plate XXIII, b, and the injury resembles certain forms of codling moth injury, for which it has been mistaken. The work often continues after the fruit is gathered and placed in storage, and on account of its inconspicuous nature, is at first apt to be overlooked. It seriously affects the keeping qualities and appearance of the fruit. There are two broods each season, and the systematic use of arsenical poisons, as for the codling moth, is the best treatment that can now be recommended.

Plant Lice. Green Apple Leaf Aphis, *Aphis pomi* DeG., and Rosy Apple Aphis, probably *Aphis sorbi* Kalt., both attack and injure the apple. The former is found more especially on the terminal leaves of younger trees, and is an important pest of the nursery, where it seriously checks the growth. The Rosy Aphis attacks more especially the fruit clusters on the inside of the tree, and causes the young fruit to be small and ill-shaped. (See Report of this Station for 1909-1910, page 343.) Spraying the dormant trees with a concentrated lime-sulphur mixture to kill the eggs, and the foliage with kerosene emulsion to kill the aphids, are the principal remedies. Plate XXIV, f.

San José Scale (see under Peach, page 610).

Tent Caterpillar, Malacosoma americana Harr. The caterpillars hatch from the egg-mass late in April, and make large nests or tents in the crotches or forks of the larger branches of apple and wild-cherry trees. They remain in the nests during the night and in stormy and cloudy weather, going out of it in pleasant weather to feed. They become full grown about the middle of

June, and make white cocoons under the leaves or rubbish on the ground. Two weeks later the adults emerge as fawn-colored moths, having a wing-spread of about an inch, and lay cylindrical masses of eggs encircling the small twigs. The eggs are covered with a transparent varnish-like substance, and hatch the following spring. The nest is shown on Plate XXIII, d. Cutting and burning the egg-masses in winter, brushing off the nests in May, and poisoning the foliage are the remedies.

Other Insects. There are many other insects attacking the apple; the fall web worm and the borer are distributed throughout the State, but as they were not noticed especially in the orchards under experiment, they are not described here. The gypsy and browntail moths are also important apple pests, but as the former is known to be present in Connecticut only at Stonington and at Wallingford, and the latter only in the extreme northeastern corner of the State, it was deemed best to omit them from this paper.

General Results of Spraying Apples.

Injury. Leaf Burn. Spraying injury generally shows in two ways; namely, spotting of the leaves and russeting of the fruit. The injury to the leaves may show as a general burning of the edges, or as interior isolated spots which vary from circular to quite irregular. The spots usually range from a quarter inch in diameter to much larger sizes by running together. These spots frequently so nearly resemble those caused by the black rot fungus that it is quite difficult to tell them apart, especially as the fruiting stage of the fungus rarely appears on the infected leaves. Where a fungicide produces serious injury of the leaves, there results a more or less decided leaf fall. Leaves not seriously spotted on such trees also frequently turn yellow and drop off. With the Bordeaux Mixture the injury is frequently overlooked by the orchardist if the leaves are not shed. This year, not only in our experiments, but with others who have used Bordeaux, the apple leaves suffered more or less serious spotting and leaf fall. In the experimental orchards the most serious injury resulted where the Bordeaux was used strongest and most frequently; namely, at the Smith, Station, and Ives orchards, where from a few to about one-half the leaves were dropped. The least

injury to the leaves was probably in the Jones orchard, where only two sprayings (second and third) were made with the 2-4-50 formula.

So far as the commercial lime-sulphur sprays are concerned, the injury to the foliage, even with the 1½ to 50 strength, was so slight as not to need especial mention. With the self-boiled lime and sulphur, also, there was no particular injury. With the commercial lime-sulphur sprays containing other ingredients, however, the results were quite different. "Sulfocide" was tried only at the Station farm, but each of the sprayings there produced more or less serious burning of the foliage. As Paris green without lime had been used with the "Sulfocide," a series of experiments was made on small trees with this fungicide, using it without any poison, with Paris green with and without lime, and with arsenate of lead. At a strength of 1 to 200 without a poison, the "Sulfocide" did very little harm, and none at 1 to 400, but with the addition of either Paris green or arsenate of lead at the latter strength, considerable burning resulted, though when lime was added with the Paris green this was largely reduced. Mr. Ives also used "Sulfocide," 1 to 200, with Paris green without lime, in one of his orchards, and it produced a very serious burning, with leaf and fruit fall. (See Plate XX, b.) As stated before, the chemical combination of soda with the arsenic of the poison produces some arsenate, which is soluble and very destructive to plant tissues, and therefore makes "Sulfocide" dangerous to use with insecticides. "Bogart's Sulphur Compound," first used at the Station orchard at a strength of 1½ to 50, produced considerable leaf injury, but was not tried sufficiently at lower strengths to see if this could be overcome, though in two sprayings at 1 to 75 it seemed largely diminished. "One for All," used twice on Baldwin apples in the Ives orchard at the rates of 5 and 6 to 50, produced as serious a burning with leaf fall as did the "Sulfocide." It was not tried at weaker strengths. It did not, however, russet the fruit or cause it to fall at this strength.

Injury. Russeting of Fruit. In every one of the orchards where Bordeaux was used, it produced more or less russeting of the fruit, depending on the strength of the Bordeaux and the variety sprayed. In some cases the injury was so serious as to

include a large percentage of the apples, producing a russeting that affected not only the appearance but even the size and shape of the fruit. The most injury was shown at the Rogers and Smith orchards, though it was quite evident at the Ives and Stoddard orchards. At the Station only a few trees were sprayed, and these did not produce much fruit, otherwise the injury here would have been serious. The russeting of both fruit and leaves at Mr. Jones's was less conspicuous than in any of the other orchards. The most extensive injury to a variety was shown on the Pound Sweets at Mr. Smith's, where 89.5 per cent. of the apples sprayed with Bordeaux were russeted against practically none on the unsprayed trees. At Mr. Rogers's, Mr. Stoddard's and Mr. Ives's the Baldwins also russeted seriously from the spraying, the Bordeaux trees in the first-named orchard showing an average of 42.3 per cent. russeted against 12.3 per cent. for all the checks. At Mr. Rogers's, Greenings, not included in our experiments, were badly russeted, apparently by the Bordeaux Mixture used. At Mr. Stoddard's, while the Baldwins showed a high per cent. of russeting, one of the check trees also ran very high. Table I shows that counts made from all the Baldwins sprayed with Bordeaux in our experiments gave 42.9 per cent. russeted against 19.5 per cent. on the twenty-three check Baldwins, an increase of over 23 per cent. See Plate XX, a.

While the commercial lime-sulphur sprays, and especially the self-boiled lime and sulphur, seemed to produce some russeting in certain cases as compared with their checks, this was never so general or conspicuous as with the Bordeaux. Table I shows that the average russeting of all the treatments in every orchard was lower than the average of the checks, except with the Bordeaux, where it was conspicuously higher, and with the self-boiled lime and sulphur, where it was about the same. With the other treatments, however, there were occasional trees (as in the case of a Baldwin tree at Mr. Ives's treated with the Niagara lime-sulphur) where the amount or character of the russeting was quite pronounced over that of the checks. This usually seemed to be in the nature of a sun scald, being on the side of the tree and fruit most exposed to the sun.

Injury. Frost. Aside from the russeting produced by spraying, however, there was more or less in every orchard due to

some other cause, as shown by the check or unsprayed trees in these orchards. Even the same variety of trees receiving the same treatment in the same orchard shows quite a variation in the amount of russeting. The highest per cent. of russeted fruit on any check tree was 63.8 per cent. on a Baldwin in the Stoddard orchard, while another Baldwin in the same orchard (with very little fruit, however), had only 6.7 per cent. Table I shows that the average russeting on seventy-nine trees, on which seven different fungicides were used, was only slightly higher (21.7 per cent.) than that of the thirty-three check trees of the same varieties, which was 18.4 per cent. Of course part of this russeting may be natural, but on the whole we believe that it was largely due to the unusually late frosts the past season in May and early June, which were serious enough in certain parts of the State to kill the foliage of scrub oaks, etc. These frosts were most serious in the northern part of the State, and were most evident in a given region in the low spots, a few feet in some instances making quite a difference in injury to the vegetation. This may explain the difference shown by the same varieties in the same orchard. For instance, the check Baldwin which was seriously russeted in the Stoddard orchard was in a lower place than any of the other Baldwins from which counts were made. Likewise, the Smith, Jones and Station orchards, which are nearer the Sound, where the frosts were less severe, showed less russeting than the Ives and Rogers orchards further inland, and still less in comparison with the Savage and Stoddard orchards still further north. Of course the varieties were not the same in all the orchards, which also has to be taken into account. We have seen apples injured almost as badly as those shown on Plate XX, a, which have not been sprayed, though as a rule such fruit is much more common on the sprayed than on the unsprayed trees.

Benefits. General. It was not the purpose of these experiments to show increased yields due to spraying, so no account was taken of the total yield of different trees under different treatments. Even if this had been the case, the unevenness of blossoming this year was enough to prevent obtaining data of value. However, there is no reason to doubt that where spray injury did not occur, there was an increase in the number and size of the apples. This was especially shown in the Jones

orchard, where the windfalls were much more numerous from the unsprayed than from the sprayed trees. Likewise, the data obtained do not take into consideration the benefit to the foliage in preventing insect and fungous attacks. It was very evident at the end of the season at the Station and Jones orchards at least (see Plate XIX), that the foliage of the sprayed trees was of a better color and was retained longer than that of the unsprayed trees. This has its effect on succeeding crops.

The data obtained merely relate to the character of the fruit with respect to its freedom from insects, russeting and fungi. Table II shows the relative results obtained by the different treatments in the different orchards. To explain this more fully, we find, for instance, that in the Ives orchard there were trees treated with Bordeaux, Niagara lime and sulphur, self-boiled lime and sulphur, besides the check trees. Of these the Bordeaux trees stood fourth, or last, in per cent. of perfect apples, and also fourth in number of russeted apples, while as regards the least number of apples attacked by fungi and insects, they stood first in each case. As three of the treatments were tried in only one or two orchards, we have omitted consideration of them, and have taken the average standing of the other treatments and compared them with the average ranks as obtained from the average total percentages given in Table I, with the following results:

	Perfect.			Russeted.			Fungi.			Insects.		
Rank in Table......	I	II	Av. rank.	I	II	Av. rank.	I	II	Av. rank.	I	II	Av. rank.
Bordeaux	6	6	6	6	6	6	2	1	1½	4	1	2½
Grasselli	2	4	3	2	2	2	3	5	4	3	5	4
Niagara	3	1	2	3	1	2	4	4	4	2	2	2
Sherwin-Williams .	1	2	1½	1	2	1½	5	3	4	1	3	2
Self-boiled	4	3	3½	4	5	4½	1	1	1	5	4	4½
Check	5	5	5	5	4	4½	6	6	6	6	6	6

This shows that the Bordeaux and check trees had the least perfect fruit. With the Bordeaux this was due to a high per cent. of russeted fruit caused by the spraying, while with the

check trees it was due to a greater per cent. of insect and fungous attack, due to lack of spraying. It will also be seen from this table that the fungicides producing the least russeting were those having apparently the least fungicidal value.

Benefit. Fungi. The past season on the whole was quite unfavorable for a general development of fungous diseases of the apple. While the early, wet, cold spring favored the development of scab and rust, the very dry summer and fall were equally unfavorable for the fruit specks and sooty blotch. In all of the orchards under experiment the injury by fungi was comparatively small, and this was especially true of the orchards that had been sprayed in previous years for fungous troubles. The following table shows the per cent. of the fruit attacked by fungi on all of the trees in the different orchards:

	Sprayed.	Unsprayed.	
Ives	2.4%	4.8%	
Jones	11.4%	31.9%	
Rogers	2.7%	3.1%	
Savage	1.4%	1.4%	(sprayed with arsenate of lead)
Smith	5.0%	10.8%	
Stoddard	5.8%	11.5%	

While in all of the orchards the sprayed trees gave lower per cents. of fungi, as shown by the above table, the fungi were too inconspicuous even on the check trees in three of the orchards to expect any decided results from spraying. All these orchards where the percentages of fungi on the check trees were over 10 per cent. had not been sprayed before, and the per cent. in one of these, the Jones orchard, was greatly increased because the counts included apples from the ground as well as from the trees. The low per cent. of fungi of the season is best shown by Table I, which gives the average per cent. for all the unsprayed trees of all the orchards as only 5 per cent., which was reduced on the sprayed trees to 3.5 per cent.

As regards particular fungi, we may state that while the season was on the whole favorable for scab, the varieties in the experiments were not very susceptible to this trouble, so even on the checks, or unsprayed trees, it was not abundant enough to determine the real value of the different sprays in controlling it. Sooty

blotch, while not specially conspicuous, appeared on the checks in the Smith and Stoddard orchards in sufficient amount to show that the sprayed trees were benefited by the treatments. Rust was the most frequent fungus in all the orchards, when we take into consideration the fact that only certain varieties are attacked by it. So far as the spraying as a whole was concerned, however, the sprayed trees did not have any less rust than the unsprayed. Individual trees in some cases seemed to show less, due to the spraying. With this fungus it seems essential that all four treatments be given in order to make any headway against it, and none of the orchards had this number. Rot was also a common fungous trouble in the orchards, and much of the benefit derived from the spraying was due to its prevention. In this respect the arsenate of lead was as helpful as the fungicides, since most of the rot followed insect injury.

Concerning the fungicidal value of the different sprays, the season was not such as to give them a fair test, but so far as the evidence goes it shows that the commercial lime-sulphur sprays were not quite equal to the Bordeaux or the self-boiled lime-sulphur. On the whole, the Bordeaux gave the better performance, since in two of the three orchards where it and the self-boiled lime-sulphur were used it ranked higher.

Benefit. Insects. The work of the codling moth was the principal insect injury appearing on the fruit at harvest time, and generally speaking it equalled or exceeded the sum total of all other insect injuries. In fact, it probably caused even greater injury than the percentages would indicate, as doubtless many of the scars and pits accredited to "other insects" were really caused by the codling moth. From the figures it appears that the codling moth was more prevalent in the Jones orchard than elsewhere, which is probably true; yet lest the reader be misled, it should here be stated that at harvest time most of the fruit, especially from the unsprayed trees, was on the ground, as the result of a storm a few days before. Hence, in order to get apples to count it was necessary to include the windfalls. As the crop here was small at the most, other things being equal, we might expect a larger proportion of the apples to be wormy. These trees had not been sprayed previously with poison, as they had been in some of the other orchards.

ABLE I.—COMBINED DATA ON SPRAYING FROM ALL SIX APPLE ORCHARDS.

Treatment.	Variety.	Trees Sprayed.	Trees Counted.	Total Apples.	Perfect.		Russeted.		Fungi.		Insects.		Irregular.
					No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	
Bordeaux Mixture	Baldwin	....	11	6552	3225	49.2	2808	42.9	68	1.0	506	7.7	3:
	Greening	....	3	1196	776	64.9	233	19.5	78	6.5	227	19.0	
	Pound Sweet	....	2	622	43	6.9	557	89.5	14	2.3	125	20.1	...
	Russet	....	3	1065	691	64.9	8	0.8	101	9.5	277	26.0	...
	Totals	74	19	9435	4735	50.2	3606	38.2	261	2.8	1135	12.0	...
Grasselli L. & S.	Baldwin	....	8	3172	2055	64.8	692	21.8	109	3.4	349	11.0	...
	Pound Sweet	....	3	1220	1098	90.0	..	....	54	4.4	68	5.6	...
	Russet	....	1	229	154	67.2	3	1.3	18	7.9	54	23.6	...
	Totals	44	12	4621	3307	71.6	695	15.0	181	3.9	471	10.2	...
Niagara L. & S.	Baldwin	....	10	5129	3315	64.6	1214	23.7	162	3.2	452	8.8	2
	Pound Sweet	...	2	1021	864	84.6	....	....	40	3.9	132	12.9	...
	Russet	....	1	623	475	76.2	2	0.3	72	11.6	76	12.2	...
	Totals	55	13	6773	4654	68.7	1216	18.0	274	4.0	660	9.7	...
Sherwin-Williams L. & S.	Baldwin	....	8	3175	2197	69.2	640	20.2	82	2.6	280	8.8	...
	Pound Sweet	....	3	2385	2110	88.5	....	....	155	6.5	122	5.1	...
	Russet	....	1	134	110	82.1	0	0	16	11.9	8	6.0	...
	Totals	45	12	5694	4417	77.6	640	11.2	253	4.5	410	7.2	...
Blanchard L. & S.	Greening	....	3	187	106	56.7	21	11.2	8	4.3	71	38.0	...
	Russet	....	2	577	297	51.5	2	0.3	50	8.7	242	41.9	...
	Totals	13	5	764	403	52.7	23	3.0	58	7.6	313	41.0	...
Self-Boiled L. & S.	Baldwin	....	7	3945	2634	66.8	901	22.8	34	0.9	365	9.2	1
	Greening	....	2	305	149	48.8	37	12.1	27	8.8	113	37.0	...
	Russet	....	2	434	219	50.5	0	0	61	14.1	172	39.6	...
	Totals	22	11	4684	3002	64.1	938	20.0	122	2.6	650	13.9	...
Arsenate of Lead & Sulphur	Baldwin	....	5	1672	1204	72.0	288	17.2	24	1.4	157	9.4	
	Greening	....	2	495	448	90.5	....	....	18	3.6	29	5.9	...
	Totals	26	7	2167	1652	76.2	288	13.3	42	1.9	186	8.6	...
Arsenate of Lead	Baldwin	....	3	1225	876	71.5	205	16.7	27	2.2	137	11.2	...
	Russet	....	1	587	406	69.2	2	0.3	94	16.0	87	14.8	...
	Totals	24	4	1812	1282	70.7	207	11.4	121	6.7	224	12.4	...
Checks	Baldwin	...	23	11058	6681	60.4	2160	19.5	336	3.0	1949	17.6	12
	Greening	....	4	1420	654	46.1	322	22.7	204	14.4	309	21.8	
	Pound Sweet	....	3	638	454	71.2	....	....	68	10.7	121	19.0	...
	Russet	....	3	381	94	24.7	...	....	44	11.5	260	68.2	...
	Totals	....	33	13497	7883	58.4	2482	18.4	652	4.8	2639	19.6	...
	Totals 1 to 7	....	79	34138	22170	64.9	7406	21.7	1191	3.5	....	...	...
	Totals 8 to 9	....	37	15309	9165	59.9	2689	17.6	773	5.0	....	....	...
	Totals 1 to 8	....	83	35959	.....	...	....	....	....	....	4049	11.3	...

TABLE II.—RELATIVE RANKS OF TREATMENTS AS TO MOST PERFECT

Treatment.	Ives.				Jones.				Rogers.			
	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.
Bordeaux	4	4	1	1	3	4	3	2	7	7	1	1
Grasselli L. & S.	....	....	....	....	....	....	....	....	2	2	7	3
Niagara L. & S.	1	1	3	2	....	....	....	....	1	1	6	2
Sherwin-Williams L. & S.	....	....	....	....	....	....	....	....	3	3	3	4
Blanchard L. & S.	....	....	....	....	1	1	1	3	....	....	....	....
Self-Boiled L. & S.	2	3	2	3	2	2	2	1	4	5	2	6
Arsenate of Lead & Sulphur	....	....	....	....	....	....	....	....	5	6	4	5
Arsenate of Lead	....	....	....	....	....	....	....	....	....	....	....	....
Check	3	2	4	4	4	3	4	4	6	4	5	7

The treatment, however, reduced the total insect injury more than one-half in all cases, and in the Stoddard orchard more than three-fourths, as an inspection of the figures will show.

The following table shows the average percentages of all kinds of insect injury to the fruit from all trees of the different orchards:

	Sprayed.	Unsprayed.
Ives	7.7%	14.4%
Jones	40.0%	83.1%
Rogers	6.7%	19.1%
Savage	15.4%	no check
Smith	8.5%	18.9%
Stoddard	8.9%	40.2%
Average for all orchards	14.53%	35.12%

The different sprays containing the same amount of poison show no marked difference in results in the averages of the six orchards. From this we may be reasonably certain that the arsenate of lead is fairly effective in destroying biting insects when combined with any of the lime-sulphur mixtures tried, or with Bordeaux.

SPRAYING EXPERIMENTS WITH PEACHES.

Details of Experimentation.

Object. In 1900, Sturgis, while botanist of the Station, conducted extensive spraying experiments with peaches for the prevention of scab and rot. These experiments showed that it

FRUIT (P.), AND LEAST RUSSETING (R.), FUNGI (F.), INSECTS (I.)

Savage.				Smith.				Stoddard.				Average of all six Orchards.			
P.	R	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.	P.	R.	F.	I.
5	5	5	3	5	5	1	5	5	6	1	2	6	6	1	1
4	4	1	5	1	1	3	2	4	3	3	4	4	2	5	5
3	3	2	2	3	1	2	3	1	2	4	3	1	1	4	2
2	2	4	4	2	1	4	1	3	4	2	1	2	2	3	3
....	....	....	....	....	....	....	....	....	....	....	....	3	5	1	4
1	1	3	1	....	....	....	....	2	1	6	5	....	....	....	....
....	....	....	....	4	1	5	4	6	5	5	6	5	4	6	6

was dangerous to spray peaches when in foliage with most of the fungicides then in use, and especially with Bordeaux. Of the various fungicides tried by Sturgis, potassium sulphide, rate of 1 lb. to 50 gallons of water, seemed to possess considerable fungicidal value without especially injuring the foliage. In 1906, the writer, taking up this matter where Sturgis left it, started a small experiment, using Bordeaux, 4-4-50, as a winter treatment on the trees just before the buds began to swell, and the half strength, 2-4-50, after the blossoms fell, and expected to make further sprayings with potassium sulphide, but the half-strength Bordeaux produced such serious shot-hole injury to the foliage, with subsequent leaf fall, that further sprayings were abandoned as useless.

Encouraged by the success attending Scott's experiments in Georgia with the self-boiled lime and sulphur, as shown by his bulletin* and a lecture before the Connecticut Pomological Society† in February, 1910, we took up this line of work again last season. Since Bordeaux had caused serious injury even at half strength, this fungicide was not included in the tests. The need for some remedy for the brown rot and scab is shown by the serious injury caused by these fungi in seasons at all moist, especially by the rot if wet weather prevails at harvest time. In fact, some of the early varieties, as Triumph, are not much grown now because of sure loss through rot. Besides the ques-

* U. S. Dept. Agr., Bur. Pl. Ind., Bull. 174, 1910.

† Ann. Rept. Conn. Pom. Soc., XII, 160, 1910.

tion of an efficient fungicide to prevent scab and rot, there is also the question whether or not effective results can be obtained with only two or three sprayings, since the expense and labor involved in more would greatly hinder the general introduction of any treatment in the peach orchards of the State.

Orchards Under Experiment. For the purpose of a preliminary test, three orchards, where experiments with spraying apples were conducted, were selected for experiment with peaches. These orchards were those of Mr. Jones, Mr. Ives and Mr. Rogers. At each place varieties especially subject to rot were chosen, viz., Triumph at Ives's, Champion at Jones's, and Waddell at Rogers's. By far the most extended experiments were conducted at the Jones orchard, as this was the handiest for the work. While the season, as a whole, except one week early in September, was not such as to develop rot especially, sufficient data were obtained to show that both the scab and rot can be greatly lessened by spraying, and without injury such as is caused by Bordeaux. The data from these orchards were taken at harvest time, when all the fruit on the trees was counted (about 25,000 peaches) and the percentages of sound and injured peaches obtained. Altogether about 125 trees were sprayed from one to four times and about half that number left unsprayed for checks.

Treatments. At the Ives and Rogers orchards only the self-boiled lime-sulphur (8-8-50), made up in the manner previously described under apples, was used. At the Jones orchard, however, there was used besides this, "Sulfocide" 1-400, Niagara lime-sulphur, 1-75 and 1-100, and potassium sulphide, 1-50. The Rogers orchard had been sprayed in late winter with home-made lime-sulphur, and a miscible oil had been used on the Ives orchard. The Jones orchard, however, had never been sprayed before, either in winter or in summer. On part of the trees here, therefore, Blanchard's lime-sulphur, 1 to 9, was used just as the buds began to swell, both for the San José scale and for peach leaf curl.

In all these orchards three summer treatments were given, as follows: (1), May 12-19, soon after the blossoms fell; (2), June 3-9, on the young fruit; (3), July 6-12, on the large fruit.

At the Jones orchard, however, certain of these treatments were omitted and various combinations made on certain sets of trees, to determine if possible what sprayings proved the most beneficial for certain troubles. Usually, in the first and second treatments at each place, arsenate of lead, rate of 3-50, was added to the fungicide used.

The most common and serious fungous and insect troubles of peaches in Connecticut are briefly described in the following paragraphs. Peach yellows, a physiological trouble, causes perhaps more serious, and certainly more permanent injury than any of these, and while we do not know definitely its cause, we do know that spraying does no good, so it is not included in these descriptions.

Fungous Diseases.

Brown Rot, Monilia fructigena. This is the fungus that causes the common rot of peaches, both in the orchard and the market. It is also the cause of rot of plums and cherries, and less frequently of pears, apples and quinces. The summer spore stage is frequently to be seen as small, thickly placed, dusty tufts covering the rotten surface. Usually only the ripening fruit is attacked, but occasionally, through insect injury, the green fruit, especially of cherries, becomes rotten. The summer stage of the fungus lives over winter on the branches of peach trees and, if the weather is right at blossoming time, not only the flowers, but the leaves and small twigs are infected and killed. The mature leaves suffer no injury except occasionally, when in contact with the rotten fruit. The summer stage also carries over on the mummies that remain attached to the tree. Those mummies that fall to the ground and become half buried in the soil, however, frequently develop in early spring the mature stage of the fungus, which is entirely different in appearance from the summer stage. This stage looks much like a minute toadstool, having a slender stem and expanding above into a funnel-shaped fruiting body. The spores from these are carried up to the blossoms. The destruction of these mummies after harvesting, including those both on the tree and on the ground, helps to lessen but does not prevent this disease. Also, thinning the fruit where it sets too abundantly, thus keeping the peaches from contact with each other, and spraying to lessen insect injury, are helpful

preventive methods; but the most benefit comes from spraying with fungicides, as described above. Plate XXII, b.

Leaf Curl, Exoascus deformans. This is a fungous trouble that seriously injures only the leaves. It develops on them early in the spring, gaining entrance while they are quite young, and when abundant, causes serious defoliation. Later on the trees may repair this injury by a new set of leaves, but the fruit will suffer indirectly, either through spring drop or smaller size. The fungus, gaining entrance to the leaves, ramifies through their tissues, and by attacking them in their young state, causes more or less curling and distortion. The leaf, also, has at first a reddish or yellowish tint, while the infected tissues show a whitish bloom when the fungus begins to produce its spores. The fungus seems to cause little or no further damage to the foliage from these spores, though they probably serve to infest or rarely to infect the young twigs or buds for another season's appearance. It has been known for some time that this trouble can be largely, or entirely, prevented if the trees are sprayed when the buds begin to swell in the spring. Sometimes a second spraying is given on the young unfolding leaves, but if the first one is just right, this second treatment does not seem to be necessary. At first Bordeaux was used as the fungicide, and as long as only the dormant trees are sprayed, no harm results. More recently the lime and sulphur sprays have been found as effective as the Bordeaux. Plate XXII, c.

Scab, Cladosporium carpophilum. The scab fungus, while it occurs on both the leaves and twigs, as well as on the fruit, causes very little injury to the former. By infecting the twigs it is carried over the winter and is ready to infect the fruit early the next season. These infected twigs, usually of the year's growth, show spots about a quarter of an inch in diameter having a purplish border. Soon after the trees blossom, these spots produce the summer spores, which are washed down on the young peaches, infecting them and spreading the fungus more or less over their surface. Usually the upper surface or end of the fruit shows these scabby spots most abundantly, thus revealing the source of infection from twigs above. The mature stage of the fungus is not known. The fruit, though

chiefly infected early in the season, does not show the fungus prominently until it has attained considerable size, from the middle of July on, when small superficial black spots cover the surface more or less abundantly. If very abundant, the fungus may cause some slight distortion of the fruit, and more frequently causes it to crack open, thus giving entrance later to the rot fungus. The chief injury, as with the sooty blotch of apples, is due to the marred appearance of the infected peaches. Two or three sprayings, the first soon after blossoming and the others at intervals of a month, practically control this trouble. Plate XXII, a.

Insect Injuries.

Curculio, Conotrachelus nenuphar Herbst. The plum curculio attacks and injures both apples and peaches, as well as plums and cherries. The adult, a small snout beetle, punctures the young growing fruit for food and for the purpose of laying eggs in it. A characteristic crescent-shaped mark is cut around the egg, which has been deposited just beneath the skin. Most of the eggs do not hatch in the apple, but make it gnarled and ill-shaped, while with other fruits the grub feeds inside, causing the fruit to fall to the ground and decay. The insect then pupates in the soil. There is but one brood each year, and spraying the foliage with arsenical poisons reduces the injury to a minimum. Jarring is often practiced on peach, plum and cherry trees. Plate XXIV, g, h.

Peach Sawfly, Pamphilius persicum MacG. During June the adult four-winged fly comes from the ground, and on the under sides of the peach leaves lays white eggs, which hatch in from six to eight days. The pale-green caterpillar rolls the edge of the leaf over itself, making a case in which it lives and feeds upon the leaf, becoming full grown in from eight to ten days. It then goes into the ground, where it passes the following winter, then transforms to the pupa stage, and later to the adult. The caterpillars usually work first on the leaves in the center or more shaded portion of the tree, but when abundant, they soon defoliate it. The remedy is to spray the leaves late in June and early in July with lead arsenate, using about 2 lbs. to 50 gallons of water. Between 4,000 and 5,000 trees in one orchard were sprayed in 1907. The work of this insect is shown on Plate XXIII, a.

San José Scale, Aspidiotus perniciosus Comst. This is a small circular scale found on the bark, leaves and fruit, and well distributed about the State. Each individual sucks the sap for its food, and is covered by a shell of wax which it secretes. There are three or four generations each year, and the species multiplies very rapidly. The remedy is to spray the dormant trees with the lime-sulphur mixture or with one of the miscible oil preparations. For further information the reader should consult Bulletin 165 of this Station. See Plate XXIII, c.

Other Insects. The peach borer, canker worm, and fall web worm are sometimes destructive pests of peach trees, but they were not particularly noticeable in these experiments, and are therefore not described here.

General Results of Spraying Peaches.

Injury. The use of the self-boiled lime-sulphur caused no injury by burning the leaves. There is some objection, however, to this fungicide if sprayed so late that the sediment is prominent on the fruit at market time, thereby injuring its sale. There has been some complaint of this trouble from other states, and at the Rogers orchard on the Waddell, which matures very early, there was sediment enough showing on the under sides of the peaches to slightly affect their marketing. Ordinarily, however, the season would not be as dry as the past one, and most of the sediment would be washed off. On the other hand, if no spray adheres to the fruit at the time of its ripening and wet weather occurs then, the rot is likely to do considerable injury. Everything considered, it does not seem wise to spray with the self-boiled lime-sulphur later than the middle of July, and ordinarily with the two previous treatments this should still be effective, with rains at harvest time. If a later spraying should be required, however, for an unusually rainy July or August, it should be made with a commercial lime-sulphur mixture or with potassium sulphide.

"Sulfocide," rate of 1 to 400, did no injury at the Jones orchard, though the same strength on young trees elsewhere caused more or less shot-hole and leaf fall. Used weaker than the above, it would hardly seem to have much value as a fungi-

cide. The use of either Paris green or arsenate of lead with "Sulfocide" on peaches is certainly very dangerous, as shown by almost complete defoliation of trees in the Jones and Station orchards with subsequent fruit drop. The young twigs were also more or less severely injured. Some few were killed outright, while others showed purplish spots, similar to those caused by the scab fungus. Potassium sulphide, rate of 1 to 50, produced no serious injury on the peach trees, but when either Paris green or arsenate of lead was added, the damage was even more severe than that caused by "Sulfocide." It is quite evident that neither of these fungicides can be used with the above insecticides, without danger of not only defoliating the trees, but even killing them *with the soluble arsenate that is formed. With the commercial* lime-sulphur (Niagara being the only brand tried, however,) there is not this danger of injury where an arsenical insecticide is used. As, at a strength of 1 to 75, some little injury to the foliage was observed with the Niagara lime-sulphur, it does not seem wise to use these preparations stronger than 1 to 100.

Benefits. General. Before proceeding to a discussion of the effect of the spraying in preventing the individual fungous diseases, we will consider, as far as possible, the respective merits of the different fungicides in controlling these troubles as a whole, as shown in the Jones orchard. In the first place, the serious injury resulting from both the potassium sulphide and the "Sulfocide" on the second summer treatment, caused by the use of arsenate of lead in them, makes it impossible to determine their real fungicidal value, since most of the trees were included in this treatment, and none produced any fruit of consequence, due to the serious drop that followed. In Table III the per cents. of the few peaches from both the "Sulfocide" and potassium sulphide treatments show that neither gave results equal to the checks as regards scab, and that the potassium sulphide alone showed any improvement as regards rot. Potassium sulphide, without the use of a poison which makes it dangerous, would, we believe, show benefit in reducing both scab and rot, if used in three summer treatments similar to those given with the self-boiled lime-sulphur. "Sulfocide," owing to the weak strength that must be used and the danger in combining it with insecticides, does not merit use at all in peach orchards.

With both the self-boiled lime-sulphur and the Niagara lime-sulphur there was a decided improvement in the sprayed fruit over the checks, and the data for these were sufficient to prove that this was due to the treatments. Table III shows that the trees sprayed with the self-boiled lime-sulphur gave an average of 68.5 per cent., and those sprayed with Niagara lime-sulphur 63.1 per cent. perfect fruit, as against the 28.2 per cent. on the check trees with a winter treatment and 20.8 per cent. on checks with no treatment at all.

Benefits. Leaf Curl. The winter treatment with Blanchard's lime-sulphur, rate of 1 to 9, in the Jones orchard, where the only spraying was made for leaf curl, showed that if a commercial lime-sulphur is sprayed on the buds at just the right time it is very effective in controlling this trouble. In fact, Bordeaux could have given no better results. The spring of 1910 was very favorable for the development of leaf curl in orchards all over the State, there being more than we have seen before. On the forty trees sprayed on April 1st with the Blanchard lime-sulphur, a careful examination was made for leaf curl on May 17th (after which it failed to spread further), and only sixty-two infected leaves were found, or an average of one and one-half to a tree! Eleven unsprayed trees gave at the same time by actual count 1,459 leaves having the curl, or an average of 132 per tree. As the trees, as shown by counts on one, had in round numbers about 4,300 leaves, this would give about 3 per cent. average infection for the check trees. Individual trees, however, went very much higher than this.

Benefits. Rot. Contrary to their usual custom, the Waddell peaches in the Rogers orchard did not rot badly this season, even where not sprayed, as the seven checks showed an average of only 2.6 per cent. rotten. This was reduced by the three sprayings with the self-boiled lime-sulphur on ten trees to an average of 1 per cent. At the Ives orchard, where only four trees were sprayed, each three times, with self-boiled lime-sulphur, the two sprayed Triumphs showed only 21.3 per cent. and 24.5 per cent. rot against 66.5 per cent. rot on the unsprayed Triumph. Two sprayed Carmen had only 8 per cent. and 5.2 per cent., but there was no check tree for comparison. At the Jones orchard (see Table III) the

average total rot of the self-boiled treatments was only 22.3 per cent. and that of the Niagara lime-sulphur treatment 24 per cent., as against 65.6 per cent., the average on the check trees. The data from the Jones orchard show that the winter treatment gives so little benefit in lessening rot that it may be omitted. As regards number and importance of the summer sprayings, the data from the self-boiled and the Niagara lime-sulphur treatments does not always entirely coincide, as in some cases a single summer treatment gave a little better result than this with an additional treatment. However, in the main those trees having the three summer treatments had the least rot, and in a wet season this would certainly be so. The total average per cents. of rot on the self-boiled lime-sulphur trees with different applications are shown as follows: Second, third and fourth treatments, only 14.2 per cent.; third and fourth, 25.2 per cent.; first and second, 39.5 per cent.; third, 16.4 per cent.; fourth, 23.4 per cent.; first (winter), 50.3 per cent.; checks (average of all unsprayed trees), 65.6 per cent. This shows that the trees sprayed three times in summer had over 50 per cent. less rot than those not sprayed.

Not only did the spraying prevent rot on the trees, but the sprayed fruit kept better, as illustrated by the following experiment. At the time of packing, August 29th, two baskets, each containing eighty perfectly sound Champion peaches, one from an unsprayed tree and one from a tree which had been given the three summer treatments with self-boiled lime-sulphur, were saved and examined daily. The peaches were removed and counted as soon as the first signs of rot appeared, with the following results:

Date.		Sprayed Number removed.	Unsprayed. Number removed.
August	30	0	7
"	31	7	27
September	1	7	28
"	2	34	13
"	3	12	3
"	4	11	1
"	5	2	0
"	6	3	1
"	7	3	0

This shows at the end of the third day after picking 78 per cent. of the unsprayed and only 18 per cent. of the sprayed peaches had rotted, and that at the end of the fourth day the percentages

were 94 per cent. and 60 per cent. On the whole, the sprayed peaches kept two days longer than the unsprayed, quite an important factor in marketing. One sprayed peach, in fact, never rotted, but merely dried up.

Benefit. Scab. The peaches at the Ives orchard were so free from scab that no counts were made. Also, at the Rogers orchard, scab was on the whole inconspicuous. However, on one check tree having considerably more than usual, counts showed 20.4 per cent. scabby as compared with only 0.4 per cent. on one of the sprayed trees showing an average amount. In the Jones orchard the average for all treatments was 5.2 per cent. for the self-boiled and 3.8 per cent. for the Niagara lime-sulphur, as against 13.1 per cent. on all the check trees. These differences really should be greater, since the scab on the entirely rotten peaches is so hidden that it could not be counted, and therefore a greater per cent. was missed this way on the checks than on the sprayed fruit.

As regards time and number of sprayings, the winter treatment showed no special value in lessening scab, since the average scab on all these trees, 12.9 per cent., was practically the same as for all of the checks, 13.1 per cent. The third treatment, made upon the young fruit about June 7th, was the most effective single treatment in controlling scab, but to be surely effective it should at least have the preceding or the following treatment. The best results on the whole may be expected when the three summer treatments are given. The average per cent. of scab on the fruit sprayed with self-boiled lime-sulphur is as follows for the different sprayings: First (winter treatment), 13.8 per cent.; first and second, 9.3 per cent.; second, third and fourth, 0.4 per cent.; third and fourth, 0.4 per cent.; third, 4.6 per cent.; fourth, 17.4 per cent.; checks, 18.1 per cent.

Benefit. Insects. So far as is shown by the figures, there seems to be no benefit to the fruit from the use of any arsenical poison in the spray applied in summer. In fact, the percentages of insect injury are somewhat greater on the sprayed than on the check trees. This may be accounted for, perhaps, on the ground that on the checks, most of the fruit attacked by curculio and other insects rotted and was so counted; or dropped, and was therefore not recorded. The sprayed trees, on the other hand,

through the application of the lime and sulphur, which in large measure prevented rotting and thus preserved the fruit, were able to retain much of the crop even after the insects had made their attacks upon it. Had there been present any insects feeding upon the foliage, of course the arsenical poison would have proved a benefit.

TABLE III.—TOTALS OF DIFFERENT TREATMENTS WITH PEACHES IN JONES'S ORCHARD.

Treatments.	No. of Trees.	Total Peaches.	Perfect.		Rot.		Rot and Scab		Scab.		Curculio.		Other Insects.	
			No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No	Per cent.	No.	Per cent.
elf-Boiled L. & S.	14	2084	1427	68.5	456	21.9	9	0.4	100	4.8	72	3.5	20	1.0
iagara L. & S.	15	2635	1663	63.1	622	23.6	10	0.4	91	3.4	172	6.5	77	2.9
otassium Sulphide	2	314	110	35.0	109	34.7	12	3.8	70	22.3	13	4.1	0	0
Sulfocide"	4	292	55	18.9	158	54.1	26	8.9	40	13.7	13	4.4	0	0
hecks, with winter treatment	13	2203	622	28.2	1190	54.0	63	2.9	221	10.0	87	3.9	20	0.9
hecks, with no treatment	25	2548	529	20.8	1595	62.6	77	3.0	258	10.1	68	2.7	21	0.8

RECOMMENDATIONS.

The treatment of an orchard depends largely on what fungi and insects are ordinarily injurious there. These in turn depend in large part on previous treatment, varieties grown, and character of the season. It thus happens that one orchard may require more sprayings than another to obtain similar results. Ordinarily *four or five sprayings, one of which is a winter treatment,* will control all the fungous and insect pests (with the possible exception of rust) which are likely to produce injury in any orchard in this State. Certain of these treatments, however, as stated above, may be omitted with equally good results, if the pests for which they are used are likely to be absent or inconspicuous. The following paragraphs give the time and treatments for the particular troubles.

Treatment for Apples.

First, or Winter Treatment. If San José scale is very bad, give a late fall treatment, preferably in November, with a good

miscible oil, rate of 1 to 15, and in early spring, before the buds begin to swell, spray with any of the straight commercial lime-sulphur preparations, rate of 1 to 8 (or home-made, 20-14-40). Where scale is not serious, the single spraying with lime-sulphur in the spring will do, and at the same time will serve in a small way to help protect against such fungi as live over on the twigs.

Second, or First Summer, Treatment. Where scab or rust are bad, spray the unfolding leaves with a fungicide before the blossoms open. If bud moth or canker worms are injurious, arsenate of lead may also be added as an insecticide.

Third, or Second Summer, Treatment. Soon after the petals fall, usually May 10th to 20th, use a spray containing both fungicide and insecticide, to prevent scab, rust, canker worms and codling moth.

Fourth, or Third Summer, Treatment. Same as third, but about two or three weeks later, June 8th to 10th, and for same purpose, including sooty blotch.

Fifth, or Fourth Summer, Treatment. If sooty blotch and fruit speck troubles are bad, this additional treatment (July 1st to 10th), may be made with a fungicide only.

In ordinary orchards, where no particular trouble is conspicuous and where only two treatments can be given, the third and fourth treatments, which combine an insecticide and a fungicide, are the most valuable and the ones commonly made. As regards fungicides, if Bordeaux is to be used, we recommend that the full strength formula, 4-4-50, be used only at the second (or first summer) treatment, and that the subsequent one or two sprayings be made with the 1-4-50 formula. We believe, however, that the straight *commercial lime-sulphur sprays* (those tested by us were Blanchard, Grasselli, Niagara, and Sherwin-Williams) may well be used in place of the Bordeaux at a strength of 1¼ to 1½ to 50. Arsenate of lead, rate of 3 to 50, may be combined with either of the above as the insecticide, and in orchards where fungous troubles are inconspicuous it may be used alone.

Treatment of Peaches.

First, or Winter Treatment. Same as on apple for scale, but when leaf curl also is to be prevented, the spraying with the

commercial lime-sulphur should be made just as the buds begin to swell, preferably the last week in March.

Second, or First Summer, Treatment. Spray with fungicide and insecticide for scab, rot and curculio, within a few days after the petals have all fallen, usually about May 5th to 15th.

Third, or Second Summer, Treatment. Same as second, and for same purpose, but made about one month later, June 1st to 15th, on the young fruit for above and the sawfly.

Fourth, or Third Summer, Treatment. With fungicide only, for rot chiefly, one month after third, July 5th to 15th, on the large fruit.

On the whole, we are inclined at present to recommend for *general use* only the self-boiled lime-sulphur for a summer fungicide for peaches, though our experiments indicate that the straight commercial lime-sulphur sprays (we used Niagara only) at a strength of 1 to 100 may be as valuable. With the self-boiled lime-sulphur, however, the last spraying should never be made later than the middle of July, and in a dry season some risk is run from a thorough treatment then, on account of the sediment that may adhere to the fruit at market time. Possibly this last spraying might be given with a straight lime-sulphur mixture, 1 to 100, or with potassium sulphide, 1 to 50. We do not advocate the use of "Sulfocide" on peaches, and under no conditions should this or potassium sulphide be used in combination with an insecticide, as serious spray injury is almost sure to result. Arsenate of lead, rate of 3 to 50, may be used in the second and third treatments in the case of the self-boiled lime-sulphur and the straight commercial lime-sulphur sprays. If only two treatments can be given the orchard, the third and fourth are the most important, or if three can be given, the second, third and fourth, but these will not stop leaf curl or San José scale.

CO-OPERATIVE EXPERIMENTS IN 1911.

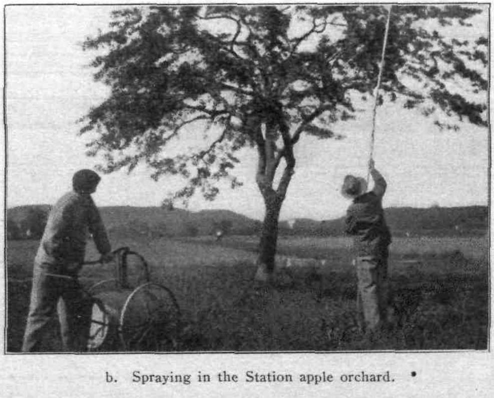
In order to test further the commercial lime and sulphur sprays, the self-boiled lime and sulphur, and perhaps one or two others in 1911 on a greater variety of fruit trees, including cherry, plum, pear and quince, as well as on the apple and peach, the Station wishes to arrange co-operative experiments with

those growing one or more of these fruits for the market, especially if their trees have been subject to serious attack by fungi or insects.

In most cases it is desired merely to make a preliminary visit to the orchard before the summer spraying season commences and to arrange details as to manner and times of spraying certain trees by the owner, leaving a few trees as checks. Then at harvest time the Station wishes to obtain data as to the results from certain of these trees. In a few cases, however, where the conditions indicate unusual opportunity for experimentation as regards particular troubles, the Station will take charge of the spraying, etc.

Any fruit grower who wishes to coöperate along these lines should communicate with the Director of the Experiment Station as soon as possible, so that details may be arranged.

a. Winter treatment in the Jones apple orchard.



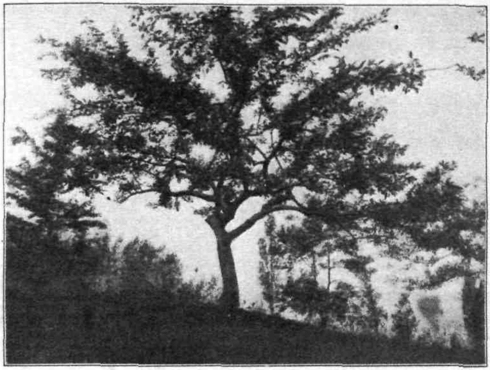
b. Spraying in the Station apple orchard.

METHODS OF SPRAYING.

a. Apparatus used in the Ives apple orchard.

b. Spraying peaches in the Rogers orchard.

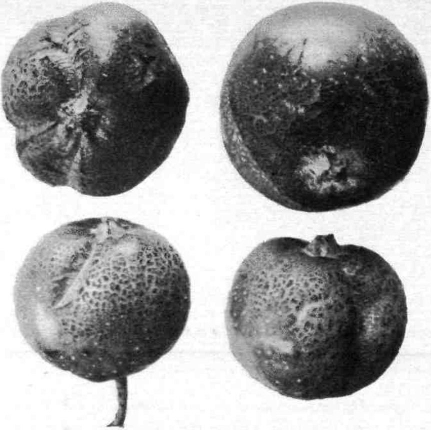
METHODS OF SPRAYING.



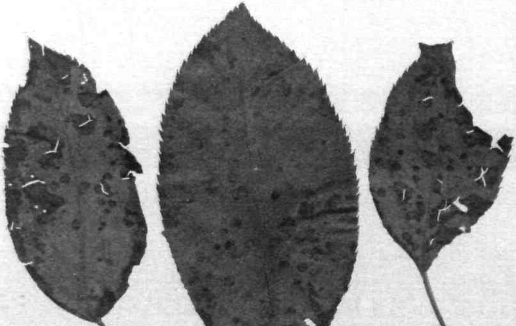
a. Tree sprayed May 16 and June 8 with self-boiled lime and sulphur.

b. Check tree which received no treatment.

APPLE TREES PHOTOGRAPHED OCT. 4 IN JONES ORCHARD.

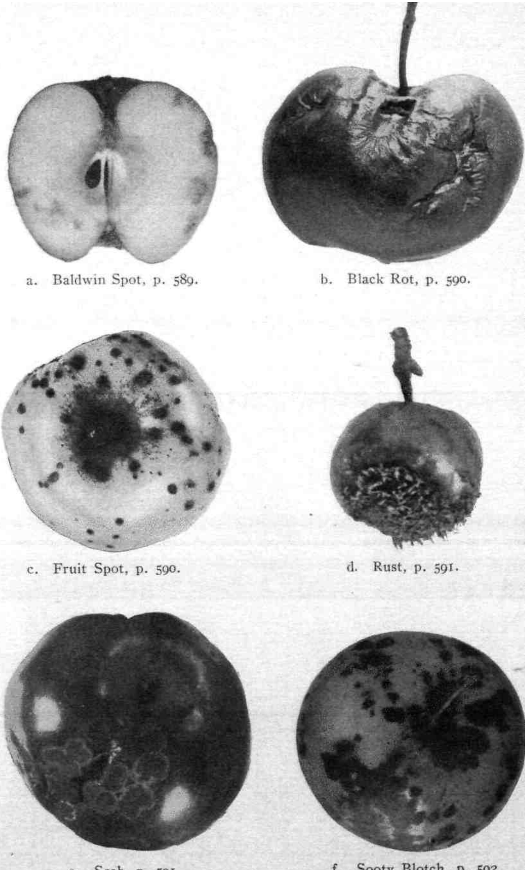


a. Fruit Russet caused by Bordeaux.



b. Leaf burn caused by "Sulfocide."

INJURIES PRODUCED BY SPRAYING



a. Baldwin Spot, p. 589.

b. Black Rot, p. 590.

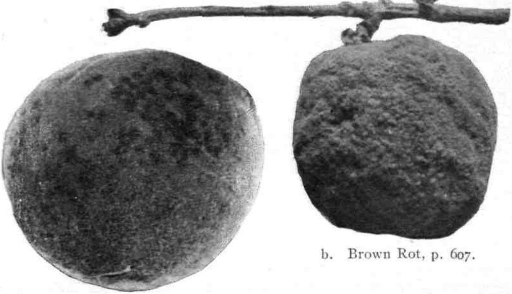
c. Fruit Spot, p. 590.

d. Rust, p. 591.

e. Scab, p. 591.

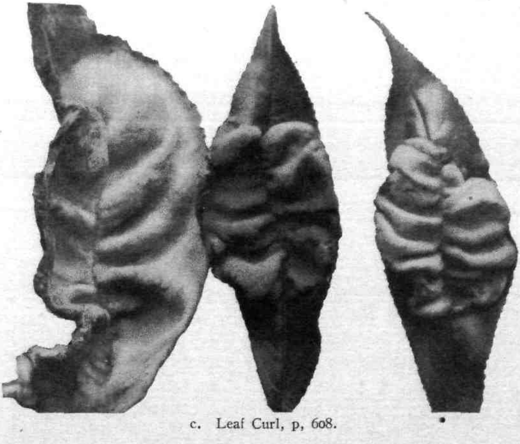
f. Sooty Blotch, p. 592.

FUNGOUS DISEASES OF APPLE.



b. Brown Rot, p. 607.

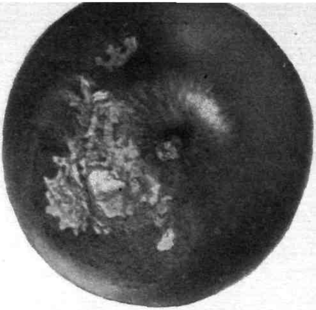
a. Scab, p. 608.



c. Leaf Curl, p, 608.

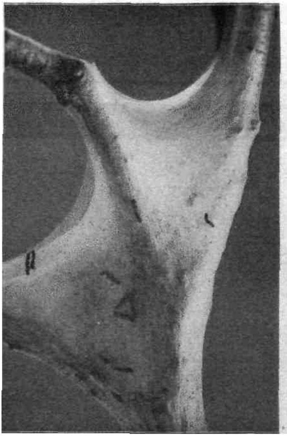
FUNGOUS DISEASES OF PEACH.

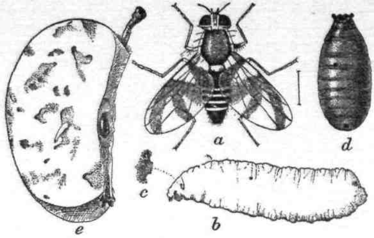
a. Work of Peach sawfly.



b. Apple injured by lesser apple worm.

c. San José Scale, much enlarged.



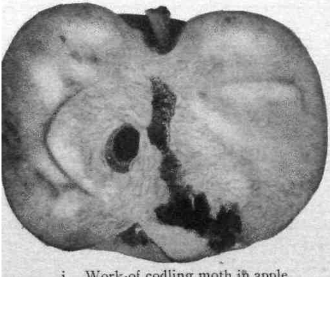


a. Apple maggot or railroad worm, adult; b. Larva; c. Spiracle of larva; d. Puparium; e. Apple showing injury; All enlarged. [After Quaintance, Bur. Ent., Circ. 101.]

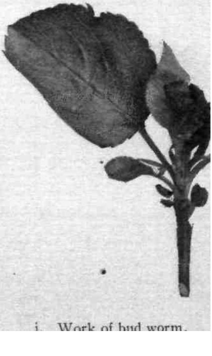
f. Green apple aphis.

g. Plum curculio much enlarged.

h. Newly set peach showing crescent marks of plum curculio.



i. Work of codling moth in apple.



j. Work of bud worm.

PART VIII.

COMMERCIAL FEEDING STUFFS.

By E. H. Jenkins and J. P. Street.*

THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following*:—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentage of protein and fat contained in it.

Section 4593 requires every manufacturer, importer, agent, or seller to file with this station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this station to take samples from any manufacturer, importer, agent, or dealer, in a prescribed fashion, and requires this station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The dairy commissioner is charged with the enforcement of the provisions of these sections of the statutes.

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* The analytical work here described has been done by Messrs. Street, Roe and Shepard. The report has been prepared mainly by Mr. Street.

In compliance with these requirements the following report has been prepared. The utmost brevity of discussion of work is made necessary by the limit imposed by law on the size of the report.

During the fall of 1910 the station sampling agent visited fifty towns and villages of this State and collected 208 samples of feeds as prescribed by law. The results of the chemical and microscopical examination of these samples are here given and discussed and the chemical analyses are given in Table III.

There are also given sixty-one analyses of samples sent by individuals.

Oil Seed Products.

Cotton Seed Meal, Sampled by the Station.

Of the eleven samples analyzed all satisfied their guaranties, except **25357** and **25382**, which were 1.17 and 0.87 per cent. low in fat, respectively. There was but little difference in the average protein and average selling prices compared with those of last year.

Cotton Seed Meal, Sampled by Purchasers.

23977. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, guaranteed 38.50 per cent. protein; sent by H. B. Coger, Botsford; contained 38.37 per cent. protein.

25208. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, guaranteed 38.62 per cent. protein; sent by C. G. Lawton, Brooklyn; contained 40.00 per cent. protein.

25634. *Dixie Brand,* same manufacturer and guaranty as last, sent by C. L. Gold, West Cornwall; contained 41.63 per cent. protein.

25635. *Dixie Brand,* guaranteed 41 per cent. protein; sent by The Coles Co., Middletown; contained 38.50 per cent. protein.

25637. Sent by The Coöperative Feed Co., North Haven; no guaranty; contained 41.88 per cent. protein.

25638. *Dixie Brand,* guaranteed 38.62 per cent. protein; sent by The "Prentice" Stores, Turnerville; contained 42.19 per cent. protein.

25643. *Dixie Brand,* guaranteed 38.62 per cent. protein; sent by Bosworth Bros., Putnam; contained 41.94 per cent. protein.

25645. Humphreys, Godwin & Co., Memphis, guaranteed 38.50 per cent. protein; sent by H. B. Coger, Botsford; contained 41.50 per cent. protein.

25893. Sent by The Coles Co., Middletown; contained 44.94 per cent. protein.

Cotton Seed Feed Meal.

The sample analyzed was 3.00 per cent. below its protein and 1.21 per cent. below its fat guaranty. Its selling price is only $2.50 below that of standard cotton seed meal, yet it contains less than half as much protein and fat, and nearly three times as much fiber. The feed is a mixture of hulls and meal. At the South a mixture of cotton seed meals and hulls is much used as feed, but Connecticut farmers cannot afford to pay freight on hulls to use for feed.

Linseed Meal, Sampled by the Station.

The two samples of new process and five of old process meal satisfied their guaranties in every case.

Linseed Meal, Sampled by the Purchaser.

25180. Sent by W. A. Kenyon, Brooklyn; no guaranty; contained 36.25 per cent. protein.

WHEAT PRODUCTS.

24827. *No. 1 Durum Wheat;* sent by Harvey Jewell, Cromwell; contained 14.38 per cent. protein.

Bran from Winter Wheat.

25302, *Cox's L-K Bran* and **25321,** *Grafton Bran,* did not have a guaranty as required by law. The other eight samples were properly and correctly guaranteed.

Bran from Spring Wheat.

All of the thirteen samples were properly and correctly guaranteed.

Of the eight samples of unclassified brans, **25264,** *New Star Bran,* **25268,** *Ogilvie's Bran,* and **25379,** *Robin Hood Bran,* did not have a guaranty as required by law; all were, however, of normal quality.

Middlings from Winter Wheat.

The five samples were properly guaranteed, and all satisfied their guaranties except **25220**, *Hecker's "H" Middlings*, which was low in fat.

Middlings from Spring Wheat.

25390 had no name of manufacturer or guaranty as required by law. The other seventeen samples were properly guaranteed, and met their guaranties except **25249**, *Pillsbury's "B" Middlings*, which was 2 per cent. low in protein, and **25229**, *Pillsbury's XX Daisy Middlings*, and **25253**, *Washburn-Crosby's Adrian Middlings*, which were both low in fat.

Of the unclassified middlings five were properly guaranteed, and one **25225**, *Mapleleaf Middlings*, was not. **25330**, *"Colonial Middlings,"* satisfied its guaranty, but its name is misleading. It is not middlings, as it contains a corn product; its selling price was only slightly lower than that of standard middlings, and it contains over 4 per cent. less protein.

Wheat Feed from Winter Wheat.

25419, *Wabash Mixed Feed*, had no guaranty as required by law. The other fourteen samples were properly guaranteed, and satisfied their guaranties except **25245**, *Hecker's Queen Mixed Feed*, which was low in fat.

Wheat Feed from Spring Wheat.

All of the twelve samples were properly and correctly guaranteed.

All of the five unclassified wheat feeds were properly guaranteed except **25305**, *Buckeye Mixed Feed*. The other samples satisfied their guaranties except **25239**, *Bull's Eye Mixed Feed*, which was slightly low in fat.

Wheat Products, Sampled by Purchasers.

25200, *"Bran,"* sampled from stock bought of Chas. Slossberg by the Norwich Hospital for the Insane. The bags when examined by our agent were not branded or tagged. The sample contained only 12.50 per cent. protein; ground corn cob was

mixed with it and it was not therefore wheat bran. **25179**, *Osota Mixed Feed*, National Milling Co., Toledo, O., sent by S. E. & W. G. Brown, Kensington, contained 16.38 per cent. protein. **25462**, *Thoroughbred Feed*, made in Lexington, Ky., sent by C. E. Beers, Newton, contained 17.06 per cent. protein.

Maize Products.

Maize Meal.

The single sample received contained 8.19 per cent. protein.

Maize (Grain).

25902 and **25903** are samples of Longfellow flint corn grown for seed in 1910 by Geo. A. Hopson, Wallingford. The first named sample was grown on land much more heavily dressed with commercial fertilizers than the other. Three samples were taken from corn grown on the farm of Col. Phelps Montgomery in 1909. **23989** is white flint, **23991** is Long Tom yellow flint and **23990** is Woods White Dent. The analyses are given below.

A comparison of composition is best made on the water-free basis. All of the flints contain considerably more protein and fat than the single dent variety. All were well cured, but as usual even late in January the dent variety contains rather more moisture than the flints.

Of the two flint varieties raised by Col. Montgomery it took 71½ pounds of ears to give 56 pounds of shelled corn and of the dent variety 77 pounds.

A struck bushel of shelled corn of one of the flint varieties weighed 55.1 pounds, of the other 58 pounds and a struck bushel of the dent variety weighed only 47.6 pounds.

Analyses.

	25902	25903	23989	23991	23990
Water	18.63	17.88	19.10	16.02	22.22
Ash	1.35	1.28	1.38	1.36	1.29
Protein	10.53	10.44	9.54	10.30	8.49
Fiber	1.04	1.15	1.06	1.09	1.47
Nitrogen-free extract	64.09	64.64	64.78	66.91	62.98
Fat	4.36	4.61	4.14	4.32	3.55
	100.00	100.00	100.00	100.00	100.00

Calculated water-free.

Ash	1.66	1.56	1.70	1.62	1.66
Protein	12.94	12.71	11.79	12.26	10.91
Fiber	1.28	1.40	1.30	1.30	1.89
Nitrogen-free extract	78.76	78.72	80.09	79.68	80.98
Fat	5.36	5.61	5.12	5.14	4.56
	100.00	100.00	100.00	100.00	100.00

An acre of yellow Leaming corn at Springside farm, New Haven, was measured by a station representative and harvested and weighed under his supervision on September 23, 1910. It was not fully mature and should have stood at least ten days longer but was harvested too early from necessity. The husked ears weighed 8647 pounds, which if figured as has been the rule in "corn contests" would have counted for 123.5 bushels of shelled corn, reckoning 70 pounds to the bushel. Thirty pounds of ears were carefully dried at the station and the water determined. From this is calculated the weight of shelled corn with fourteen per cent. of water, which was just sixty-three bushels, little more than one-half of the yield which would be figured in a "prize contest," based, as has been the general custom, wholly on the weight of the harvested ears. This is an exaggerated case which serves admirably to illustrate the unfairness of any comparison of yields which is not based *on the yield of dry matter.* The other method is based on the assumption that all corn crops have the same amount of water at husking time, and every one knows that this is very far from true.

A flint corn from S. H. Kingsbury, Scitico, which yielded 7704 pounds of ears, contained 5052 pounds of shelled corn with 14 per cent. of water.

A flint corn from J. E. Watson, Marbledale, which yielded 5106 pounds of ears per acre, contained 3803 pounds of shelled corn with the above named per cent. of water.

Another flint corn from L. S. White, Collinsville, which yielded 8400 pounds of ears, contained 5828 pounds of shelled corn, 14 per cent. moisture.

Still another of a hybrid variety, grown by W. S. Pinney, Suffield, yielded 8119 pounds of ears, or 5052 pounds of shelled corn.

Calculating the above figures first by the unfair method of 70 pounds of ears at husking time to the bushel of shelled corn and

then by the fairer method of 56 pounds of shelled corn with 14 per cent. of moisture to the bushel, we get the following yields per acre:

YIELDS OF SHELLED CORN PER ACRE IN BUSHELS.

	70 lbs. Ears to bushel.	56 lbs. Shelled Corn to bushel.
Springside	123.5	63
Scitico	110.0	90
Marbledale	72.9	68
Collinsville	120.0	104
Suffield	116.0	90

Gluten Feed, Sampled by the Station.

Six brands were found on sale in the State, and these are represented by fifteen analyses.

Atlantic Gluten Feed failed to meet its fat guaranty, but exceeded the protein guaranty by four per cent. It is made from wheat gluten and contains nearly five per cent. more protein than any of the corn gluten feeds analyzed this year, while its price is also about $3.00 higher than the average for gluten feed.

Buffalo Gluten Feed. The three samples satisfied their guaranties for protein, but one was low in fat. All were branded as artificially colored.

Cedar Rapids Gluten Feed. Neither of the two samples satisfied the protein guaranty, the deficiency averaging nearly two per cent. The fat content, however, was greatly in excess of the guaranty, indicating the possible addition of corn germ to the feed.

Cream of Corn Gluten Feed. The three samples met their guaranties. All were branded as artificially colored.

Crescent Gluten Feed. Both samples satisfied the protein guaranty, but one was low in fat. Both were branded as artificially colored.

Globe Gluten Feed. The three samples all met their protein guaranty, but two were slightly low in fat. All were branded as artificially colored.

The unnamed brand taken from the stock of Meech and Stoddard, showed a protein deficiency of 3.37 per cent.

Gluten Feeds, Sampled by Purchasers.

23978, *Atlantic Gluten Feed,* sent by Meech and Stoddard, Middletown, contained 37.81 per cent. protein. **24216,** unknown

brand, sent by Wilson H. Lee, Orange, contained 28.63 per cent. protein. **24265**, unknown brand, sent by D. E. Carroll and Co., Waterbury, through R. J. Hardy and Sons, Boston, contained 25.50 per cent. protein. **24597**, unknown brand, sent by W. W. Perry, New Canaan, contained 24.63 per cent. protein. **24858**, unknown brand, sent by N. A. Bennett, Hanover, contained 23.44 per cent. protein. **25043**, unknown brand, sent by W. C. Robinson, Columbia, contained 26.69 per cent. protein.

Hominy Feed, Sampled by the Station.

Thirteen samples were analyzed. **25266**, *Yellow Hominy Feed*, had no guaranty as required by law. The other samples were properly and correctly guaranteed except **25256**, *Buffalo Cereal Co.'s Hominy Feed*, which was 1.12 per cent. below its protein guaranty.

Hominy Feed, Sampled by Purchasers.

24275, *Miner-Hilliard Milling Co.'s Steam Cooked Hominy Feed*, guaranteed 10 per cent. protein; sent by R. H. Ensign, Simsbury; contained 10 per cent. protein. **25201**, *American Hominy Co.'s Homco Feed*, guaranteed 8.5 per cent. protein; sent by Henry N. Pollock, Norwich; contained 11.81 per cent. protein.

Star Feed.

This material is a mixture of hominy feed, corn and cob meal and a small amount of salt. The two samples satisfied their guaranties. It contains only about four-fifths as much protein as hominy feed, and nearly three times as much fiber, while its selling price is only slightly less.

RYE PRODUCTS.

Two of the four samples of rye middlings were properly and correctly guaranteed. **25292** was not guaranteed as required by law, and **25219** was low in fat.

BUCKWHEAT PRODUCTS.

The single sample of buckwheat middlings failed to reach its rather high protein guaranty of 32 per cent. by nearly 2.5 per cent.

Barley Products.

Malt Sprouts.

The two samples satisfied their protein guaranties, but **25238** was low in fat.

A sample of barley sprouts sent by Albert N. Beard, Milford, contained 28.13 per cent. protein.

Dried Brewers' Grains.

The single sample analyzed was of high quality and satisfied its guaranty.

Wet Brewers' Grains.

24498, *sent by* A. J. *Pierpont, Waterbury, contained* 6.64 per cent. protein. It sold for 10 cts. per bushel plus $2.00 per load for carting.

Dried Distillers' Grains.

The single samples of *Ajax Flakes* and *Dearborn Distillers' Grains* satisfied their guaranties, and were both high-grade products.

24859, *Corn Three D Grains* (formerly called *Corn Protegran*), made by The Dewey Bros. Co., Blanchester, O., guaranteed 26 per cent. protein; sent by W. P. Holmes and Son, Griswold; contained 31.38 per cent. protein.

Miscellaneous Feeds.

Corn and Oat Feeds.

The nine samples examined consist chiefly of corn and oats products, as their name indicates. In certain of these, however, **25284, 25243, 25315,** and **25347**, the high percentages of fiber indicate that an inferior part of the grain has been used in their compounding.

25342, *Korn-Oats,* was low in fat.

24261, sent by H. B. Coger, Newtown, contained 9.63 per cent. protein. **24860** and **24861**, sent by J. T. Benham Est., New Haven, each contained 9.50 per cent. protein.

Oat Feeds.

The three samples examined consisted chiefly of oats, the hulls being in large excess. **25265**, *Jim Dandy Feed,* also contained a

very little corn. **25380**, *Cox's Oat Feed*, was 1.25 per cent. low in protein. **25340**, *Dow's Oat Feed*, had no guaranty as required by law. At the price asked these feeds cannot be considered an economical purchase.

Wheat and Corn Cob Feeds.

These feeds, while sold as *Mixed Feeds*, a name properly belonging from trade usage only to mixtures of wheat bran and middlings, in three cases bore tags indicating the presence of corn cobs. **25262**, *Holstein Mixed Feed*, however, bore no such tag, and is adulterated under the law. Furthermore it is 1.25 per cent. below its protein guaranty. Otherwise these feeds satisfied their guaranties. They sold for about $3.50 less per ton than genuine wheat feed, and contained only about two-thirds as much protein.

Proprietary Horse Feeds.

All of the six samples were properly guaranteed. **25231**, *Bonnie Horse Feed*, was 3.25 below guaranty in protein. **25331**, *Algrane Horse Feed*, and **25410**, *Sugarota Horse Feed*, were also 1.37 and 1.19 per cent. low in protein, respectively.

Sucrene Horse and Mule Feed contains corn, oats, barley and wheat products, a few weed seeds and molasses.

Buffalo Horse Feed, Bonnie Horse Feed and *Algrane Horse Feed* contain corn, oats and wheat products.

Sugarota Horse Feed contains wheat, corn and oats products, barley residues, a small amount of cotton seed meal, a few weed seeds and molasses.

Schumacher's Special Horse Feed contains cracked corn, whole oats, oat hulls and barley.

Proprietary Dairy and Stock Feeds.

All of the twenty-five feeds of this class bore the required guaranties except **25397**, *Haskell's Stock Feed*, in which the guaranty for fat was wanting. **25287**, *Sucrene Dairy Feed*, was slightly low in both protein and fat. One sample of *Unicorn Dairy Ration*, **25240**, was 1.50 per cent. low in protein, with a considerable excess of fat; and **25366**, *Daisy Dairy Feed*, **25223**, *Algrane Milk Feed*, and **25290**, *Economy Feed*, were all below

guaranty in fat. Both of the samples of *Sugarota Milk Meal* failed to meet their fat guaranty by nearly 3 per cent.

Sucrene Dairy Feed contains distillery products, corn, oats and wheat products, cotton seed meal, a little linseed meal, malt sprouts, weed seeds and molasses.

Union Grains Ready Ration contains wheat and corn products, distillery residues, malt sprouts, and cotton seed and linseed meals.

Blatchford's Calf Meal contains linseed, cotton seed and bean meals with a wheat product and fenugreek.

Unicorn Dairy Ration contains wheat and corn products, distillery grains, barley residues, malt sprouts, cotton seed and linseed meals and a small amount of oats.

Wirthmore Stock Feed contains corn (hominy) and oats products.

White Cross Stock Feed contains corn and oats products with a small amount of wheat.

Daisy Dairy Feed contains corn and oats products, alfalfa, cotton seed meal, a few weed seeds and molasses.

Gregson Calf Meal contains linseed and cotton seed meals, and barley and oat products with fenugreek.

Sterling Stock Feed contains corn, oats and wheat products, and a small amount of cotton seed meal.

Haskell's Stock Feed contains corn (hominy) and oats products.

Algrane Milk Feed contains corn (gluten feed), wheat and oats products (much hulls) and cotton seed meal.

New England Stock Feed contains corn and oats products.

Husted Dairy Feed contains corn, wheat and oats products, cotton seed meal and possibly linseed meal.

Mayflower Stock Feed contains corn and oats products.

Zenith Stock Feed contains corn and oats, and wheat and barley products in small amounts.

Badger Dairy Feed contains distillery and brewery residues, corn and oats products, malt sprouts, alfalfa, a little cotton seed meal, a few weed seeds and molasses.

Sugarota Calf Meal contains linseed and cotton seed meals, and wheat and barley products.

Sugarota Milk Meal contains barley residues, malt sprouts, wheat and oats products, cotton seed meal and a few weed seeds.

Schumacher's Stock Feed contains corn, oats and barley products, and a small amount of cotton seed meal.

Schumacher's Calf Meal contains wheat and oats products, linseed meal, casein (statement of manufacturer), and a small amount of cotton seed meal.

Wirthmore Balanced Ration Feed contains barley residues, malt sprouts, wheat, corn and oats products, cotton seed meal and possibly linseed meal.

Economy Feed contains corn and oats products and a small amount of brewers' grains.

Dairy Feeds, Sampled by Purchasers.

24230, *Wirthmore Balanced Ration Feed*, guaranteed 26 per cent. protein and 5 per cent. fat; sent by Bosworth Bros., Putnam; contained 26.69 per cent. protein and 4.74 per cent. fat. **24889**, *Unicorn Dairy Ration*, sent by Chapin and Co., Boston, contained 26.88 per cent. protein.

Proprietary Poultry Feeds.

The nine samples all bore the required guaranties except **25217**, *Vincent Bros. Dry Mash*, to which only the formula was attached. **25322**, *Wirthmore Growing Feed*, was nearly 2 per cent. below guaranty in both protein and fat. **25248**, *Algrane Poultry Feed*, was also below guaranty in protein and fat, and **25333**, *Sugarota Scratch Feed*, was 1.75 per cent. low in protein.

Wirthmore Growing Feed contains corn, wheat and oats products.

Wirthmore Poultry Mash contains corn, oats and wheat products, alfalfa, millet, barley and weed seeds.

Algrane Poultry Feed contains chiefly wheat, oats and corn products, with a small amount of ground meat.

Husted Poultry Feed contains wheat and corn products and alfalfa.

Sugarota Scratch Feed contains corn, wheat, barley, oats, kaffir corn, sunflower seeds and buckwheat.

Park and Pollard's Dry Mash Feed contains wheat, corn, oats and barley products, alfalfa and animal matter (bone and fish (?)).

Park and Pollard's Growing Feed contains chiefly corn, wheat and oats products.

American Poultry Feed contains wheat, corn and barley products, with a little oats and cotton seed meal.

Vincent Bros. Dry Mash contains corn, wheat and oats products, linseed meal, alfalfa and meat scrap.

Poultry Feeds, Sampled by Purchasers.

23995 and **25631**, *M. and S. Scratch Feed*, made and sent by Meech & Stoddard, Middletown, contained 11.38 and 10.19 per cent. of protein, and 3.94 and 3.88 per cent. of fat, respectively. **24176**, *Dry Mash*, made and sent by D. L. Dickinson & Son, Waterbury, contained 19.13 per cent. protein and 6.68 per cent. fat. **24177** and **24178**, *Park and Pollard's Dry Mash*, both sent by W. E. Sayles, Danielson, contained 20.19 and 29.63 per cent. protein, respectively.

ALFALFA PRODUCTS.

24175. Hay, sent by Wilson H. Lee, Orange.

24217. Hay, sent by C. M. Jarvis, Berlin, and cut on his farm.

24258. Hay, sent by Wilson H. Lee, Orange, and cut on his farm.

25914. Hay, sent by C. M. Jarvis, Berlin.

24208. Feed or Meal, sent by C. M. Jarvis, Berlin.

24260. Screenings, sent by C. M. Jarvis, Berlin.

25916 and **25917**, Meal, Kornfalfa Feed Milling Co., Kansas City, Mo., sent by C. M. Jarvis, Berlin.

	24175	24217	24258	25914	24208	*24260	25916	25917
Water	.....	25.17	5.88	5.41	7.92	8.04	.....	.....
Ash	.....	7.00	7.03	7.27	9.39	7.13	.....	.....
Protein	14.87	15.20	13.88	15.00	15.63	30.00	18.00	15.19
Fiber	.....	23.93	34.26	36.17	27.60	14.86	.....	.....
Extract	.....	27.24	37.05	34.82	37.78	32.86	.....	.....
Fat	2.46	1.46	1.90	1.33	1.68	7.11	.....	.....

Rice Feed.

25175. Sent by Chas. M. Cox Co., Boston. Contained 13.44 per cent protein.

Mealine.

25042. Sent by W. C. Robinson, Columbia. Contained 18.25 per cent protein.

* Contains 3 per cent. of weed seeds.

Scrapings from Bake Ovens.

24259. National Biscuit Co. Sent by C. M. Jarvis, Berlin. Contained 6. 75 per cent protein.

Core Flour.

24321. Sent by The Turner & Seymour Mfg. Co., Torrington. Contained 21.21 per cent mineral matter.

Summary.

The following table shows the number of samples analyzed, the number sold without the required guaranty, and also the number which failed to meet the manufacturer's guaranty:

Kind of Feed.	No. of samples.	No. with Guaranty.	No. without Guaranty.	* Low in		
				Protein.	Fat.	Both.
Cotton Seed Meal	11	11	----	----	2	----
Cotton Seed Feed	1	1	----	----	----	1
Linseed Meal	7	7	----	----	----	----
Wheat Bran	31	26	5	----	----	----
Wheat Middlings	29	27	2	1	3	----
Wheat Feed	32	30	2	---	2	----
Gluten Feed	15	15	----	3	5	----
Hominy Feed	13	12	1	1	----	----
Star Feed	2	2	----	----	----	----
Corn Meal	1	----	1	----	----	----
Rye Middlings	4	3	1	----	1	----
Buckwheat Middlings	1	1	----	----	----	1
Malt Sprouts	2	2	---	----	1	----
Brewers' Grains	1	1	----	----	----	----
Distillers' Grains	2	2	----	----	----	----
Corn and Oat Feeds	9	8	1	----	1	----
Oat Feeds	3	2	1	1	----	----
Wheat and Corn Cob Feeds	4	4	----	1	----	----
Horse Feeds	6	6	----	3	----	----
Dairy and Stock Feeds	25	25	----	1	6	----
Poultry Feeds	9	8	1	1	----	2
	208	193	15	12	21	4

* Deficiencies of less than one per cent. protein and 0.25 per cent. fat are ignored in this tabulation.

Digestibility of Feeding Stuffs.

Table I shows the digestion coefficients, or percentages of the food elements which are digestible by neat cattle (Lindsey's Compilation, 17th Report Mass. (Hatch) Agrl. Station, 1905, page 240 *et seq.*):

TABLE I.

Digestion Coefficients.

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	84	35	78	94
Linseed Meal, new process	84	74	80	89
Linseed Meal, old process	89	57	78	89
Corn Meal	66	..	92	91
Hominy Meal and Star Feed	65	67	89	92
Gluten Feed	85	76	89	83
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Mixed Feed	78	62	77	87
Rye Feed	80	..	88	90
Oats	77	31	77	89
Buckwheat Middlings	85	17	83	89
Malt Sprouts	80	34	69	100
Dried Distillers' Grains	73	95	81	95
Dried Brewers' Grains	81	49	57	89
Corn and Oat Feed, provender	71	48	83	87
Wheat and Corn Cob Feed	63	28	71	92

THE AVERAGE COMPOSITION, DIGESTIBILITY AND SELLING PRICE OF COMMERCIAL FEEDS.

Table II contains a summary of the facts given in more detail in Table III, and shows, first, the average composition of these feeding-stuffs as determined by our last inspection and arranged according to their protein percentage; second, the amount of digestible matter in each feed, as far as we have been able to calculate it; and third, the average retail prices of the feeds in October and November last.

The feeds are tabulated in six groups. The following statement gives the average number of pounds of digestible protein, fiber, nitrogen-free extract and fat purchasable for one dollar in each of these groups:

Digestible Nutrients Purchasable for One Dollar.

Group.		Protein.	Fiber and Nitrogen-free Extract.	Fat.
1	Containing over 30 per cent. protein	16.4	21.4	3.3
2	" 25 to 30 " "	15.1	30.0	2.5
3	" 20 to 25 " "	12.3	36.5	5.4
4	" 15 to 20 " "	9.3	32.0	2.8
5	" 10 to 15 " "	5.4	37.2	3.9
6	" less than 10 " "	4.0	46.0	2.8

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE.

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
I. Protein over 30 per cent.											
Cotton Seed Meal	7.80	6.61	40.65	8.28	28.50	8.16	34.1	2.9	22 2	7.7	$34.55
Linseed Meal, new process	8.67	6.72	36.44	8.42	37.87	1.88	30.6	6.2	30.3	1.7	39.00
" " old process	9.00	5.39	36.17	7.49	34.90	7.05	32.2	4.3	27.2	6.3	40.00
Gluten Feed, Atlantic	7.20	0.96	32.00	1.03	58.32	0.49	27.2	0.8	51.9	0.4	32.00
Ajax Flakes	5.63	2.02	30.81	11.60	36.84	13.10	22.5	11.0	29.8	12.4	33.50
II. Protein 30-25 per cent.											
Dried Brewers' Grains	5.87	3.06	29.50	13.57	40.43	7.57	23.9	6.6	23.0	6.7	27.00
Buckwheat Middlings	10.09	4.78	29.56	10.63	37.59	7.35	25.1	1.8	31.2	6.5	32.00
Blatchford's Calf Meal	9.32	5.36	28.13	5.26	46.76	5.17	----	----	----	----	70.00
Gregson Calf Meal	7.83	5.72	27.94	4.74	46.99	6.78	----	----	----	----	50.00
Gluten Feed, Globe	8.36	4.60	27.17	6.29	51.31	2.27	23.1	4.8	45.7	1.9	28.33
Sugarota Calf Meal	9.73	4.30	26.56	4.58	48.71	6.12	----	----	----	----	70.00
Malt Sprouts	10.95	5.86	26.41	11.87	43.31	1.60	21.1	4.0	29.9	1.6	25.50
Wirthmore Balanced Ration	8.79	4.46	26.31	8.21	46.78	5.45	----	----	----	----	32.00
Gluten Feed, Crescent	8.52	4.26	25.54	6.52	51.82	3.34	21.7	5.0	46.1	2.7	28.25
" " Buffalo	9.57	5.00	25.44	6.26	51.03	2.70	21.6	4.8	45.4	2.2	29.00
" " Cream of Corn	8.18	3.10	25.25	6.46	52.87	4.14	21.5	4.9	47.1	3.4	30.00
Sugarota Milk Meal	7.90	8.32	25.22	11.63	43.68	3.25	----	----	----	----	29.50
III. Protein 25-20 per cent.											
Unicorn Dairy Ration	7.80	3.88	24.82	9.17	46.83	7.50	----	----	---	---	32.50
Dearborn Distillers' Grains	6.33	1.93	24.81	12.44	44.96	9.53	18.1	11.8	36.4	9.1	28.50
Union Grains, Biles' Ready Ration	7.76	4.79	24.28	9.13	46.25	7.79	----	----	----	----	34.00
Husted Dairy Feed	9.48	5.96	22.50	6.47	50.19	5.40	----	----	----	----	32.00
Gluten Feed, Cedar Rapids	7.06	1.21	20.10	6.41	57.67	7.55	17.1	4.9	51.3	6.3	28.50

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Wheat Middlings	9.88	4.37	17.67	6.33	56.50	5.25	13.6	1.9	44.1	4.6	$29.84
Wheat Mixed Feed	9.41	5.37	17.03	7.49	55.96	4.74	13.3	4.6	43.1	4.1	28.28
Wheat Bran	9.11	6.50	16.20	9.51	53.87	4.81	12.5	3.7	38.2	3.0	26.65
Rye Middlings	9.80	3.95	15.96	4.36	62.39	3.54	....	....	....	....	28.88
Sucrene Dairy Feed	8.75	7.72	15.63	12.78	51.87	3.25	....	....	....	....	29.00
Daisy Dairy Feed	6.15	7.65	15.50	14.33	54.19	2.18	....	....	....	....	28.00
V. Protein 15-10 per cent.											
Buffalo Horse Feed	8.87	3.42	12.19	8.51	61.62	5.39	....	....	....	....	31.00
Wheat and Corn Cob Feed	9.08	4.74	11.91	16.14	54.89	3.24	7.5	4.5	39.0	3.0	24.75
Sucrene Horse and Mule Feed	9.73	7.59	11.63	10.64	56.65	3.76	....	....	....	....	30.00
Schumacher's Stock Feed	8.77	4.18	11.13	9.20	62.70	4.02	....	....	....	....	27.00
Economy Feed	7.54	3.01	10.94	14.32	59.88	4.31	....	....	....	....	27.00
Sugarota Horse Feed	9.45	6.58	10.81	16.19	53.51	3.46	....	....	....	....	32.00
Zenith Stock Feed	9.63	2.95	10.81	5.26	66.12	5.23	....	....	....	....	29.00
Bonnie Horse Feed	9.63	2.87	10.75	8.02	64.78	3.95	....	....	....	....	31.00
Algrane Horse Feed	7.65	4.02	10.63	10.10	62.91	4.69	....	....	....	....	30.00
Sterling Stock Feed	7.86	3.98	10.25	11.14	61.50	5.27	....	....	....	....	29.00
Hominy Feed	8.95	2.55	10.13	4.01	66.58	7.78	6.6	2.7	59.3	7.2	27.92
White Cross Stock Feed	9.66	2.12	10.00	4.09	69.99	4.14	....	....	....	....	31.00
VI. Protein under 10 per cent.											
New England Stock Feed	6.80	4.40	9.94	12.05	60.80	6.01	....	....	....	....	30.00
Wirthmore Stock Feed	7.52	3.26	9.63	7.90	64.07	7.62	....	....	....	....	32.00
Haskell Stock Feed	7.36	3.31	9.44	7.03	65.64	7.22	....	....	....	....	27.00
Mayflower Stock Feed	9.64	3.41	9.19	6.52	65.31	5.93	....	....	....	....	25.00
Schumacher's Special Horse Feed	8.06	3.12	9.00	9.02	66.50	4.30	....	....	....	....	29.00
Star Feed	8.32	3.20	8.75	10.68	63.13	5.92	5.7	7.2	56.2	5.4	27.50
Corn and Oat Feeds	8.68	3.24	8.50	8.66	66.63	4.29	6.0	4.1	55.3	3.7	29.22
Corn Meal	11.78	1.30	8.19	1.88	72.89	3.96	5.4	....	67.1	3.6	26.00
Oat Feeds	6.59	6.07	5.94	25.78	53.25	2.37	4.2	12.4	44.2	2.1	24.33

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	OIL SEED PRODUCTS.	
	Cotton Seed Meal.	
25316	———. American Cotton Oil Co., Memphis, Tenn.	*Wallingford:* E. E. Hal
25357	Choice. American Cotton Oil Co., Yazoo City, Miss.	*Hartford:* G. M. White
25382	Choice. American Cotton Oil Co., Huntsville, Ala.	*Colchester:* M. Klingon
25368	Dove Brand. F. W. Brodé, Memphis, Tenn.	*Manchester:* G. W. Kuh
25393	Owl Brand. F. W. Brodé, Memphis, Tenn.	*Moosup:* T. E. Main &
25372	Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Stafford Springs:* G. L.
25370	Good Luck. S. P. Davis, Little Rock, Ark.	*Rockville:* Edward Whi
25237	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*New Haven:* R. G. Dav
25375	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Willimantic:* H. A. Bu
25234	Medium Grade. Ozark Oil Co., Ozark, Ala.	*New Haven:* R. G. Dav
25378	Prime. J. E. Soper & Co., Boston, Mass.	*Willimantic:* E. A. Buc
		Average guaranty
		Average of these 11 anal
		Average digestible
	Cotton Seed Feed Meal.	
25381	Humphreys, Godwin & Co., Memphis, Tenn.	*Colchester:* M. Klingon
		Guaranty
	Linseed Meal, New Process.	
25236	American Linseed Co., Chicago, Ill.	*New Haven:* R. G. Dav
25404	" " " " "	*New London:* P. Schwa
		Average guaranty
		Average of these 2 analy
		Average digestible
	Linseed Meal, Old Process.	
25261	American Linseed Co., New York	*Stamford:* H. S. Belling
25421	Kelloggs & Miller, Amsterdam, N. Y.	*Canaan:* Ives & Pierce
25296	Guy G. Major Co., Toledo, O.	*Ansonia:* Flour & Grain
25417	Mann Bros. Co., Buffalo, N. Y.	*Winsted:* Platt & Coe
25373	Midland Linseed Co., Minneapolis, Minn.	*Stafford Springs:* G. L.
		Average guaranty
		Average of these 5 analy
		Average digestible
	WHEAT PRODUCTS.	
	Bran from Winter Wheat.	
25246	Ballard's. Ballard & Ballard, Louisville, Ky.	*New Haven:* Abner Hen
25408	Cain's. The Cain Mill Co., Atchison, Kan.	*Collinsville:* F. W. Kono
25302	L-K Bran. *C. M. Cox Co., Boston, Mass.	*Hamden:* I. W. Beers
25321	Grafton Roller Mill Co., Grafton, N. Dak.	*Meriden:* Grain & Feed
25385	Gwinn's. The Gwinn Milling Co., Columbus, O.	*Putnam:* Bosworth Bros
25303	Dreadnought. Hunter-Robinson-Wenz Mill Co., St. Louis, Mo.	*Plainville:* F. B. Newto
25394	Anchor. Kemper Mill & Elevator, Kansas City, Mo.	*Yantic:* A. R. Manning

* Statement of Dealer.

Sampled in 1910.

	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
6	7.73	7.02	40.25	7.86	28.22	8.92	$34.00
7	7.38	7.40	43.19	6.00	28.20	7.83	36.00
2	7.67	6.12	40.81	8.29	28.98	8.13	36.00
8	8.33	5.75	38.25	10.67	30.25	6.75	34.00
3	7.32	7.32	41.50	7.86	27.80	8.20	36.00
2	8.01	5.93	39.06	9.92	30.17	6.91	34.00
0	7.23	6.95	43.94	6.91	26.51	8.46	32.00
7	8.38	7.36	40.25	8.15	27.07	8.79	34.00
5	7.91	6.26	39.13	9.00	29.19	8.51	35.00
4	8.09	6.64	40.69	8.35	28.06	8.17	33.00
3	7.81	5.91	40.13	8.04	28.98	9.13	36.00
-	----	----	**39.58**	----	----	**7.15**	----
-	**7.80**	6.61	**40.65**	**8.28**	**28.50**	**8.16**	**34.55**
-	----	----	**34.1**	**2.9**	**22.2**	**7.7**	----
1	8.07	4.05	19.00	24.69	40.90	3.29	32.00
-	----	----	**22.00**	**28.00**	----	**4.50**	----
5	8.46	6.90	37.31	8.25	37.06	2.02	38.00
4	8.88	6.54	35.56	8.60	38.68	1.74	40.00
-	----	----	**36.00**	----	----	**1.00**	----
-	**8.67**	**6.72**	**36.44**	**8.42**	**37.87**	**1.88**	**39.00**
-	----	----	**30.6**	**6.2**	**30.3**	**1.7**	----
1	8.73	4.96	38.94	7.19	33.99	6.19	38.00
1	10.17	5.48	35.56	7.40	34.80	6.59	41.00
5	8.68	5.94	32.56	8.54	37.67	6.61	40.00
7	8.47	4.77	37.56	6.85	32.61	9.74	40.00
3	8.95	5.81	36.25	7.47	35.38	6.14	41.00
-	----	----	**32.20**	----	----	**5.40**	----
-	**9.00**	**5.39**	**36.17**	**7.49**	**34.90**	**7.05**	**40.00**
-	----	----	**32.2**	**4.3**	**27.2**	**6.3**	----
	9.25	7.23	15.06	9.20	54.62	4.64	28.00
	8.96	6.72	17.13	9.14	53.76	4.29	27.00
	8.38	6.42	16.38	10.13	53.51	5.18	25.00
	8.97	6.15	15.63	11.23	53.20	4.82	29.00
	8.62	6.46	16.25	8.46	55.96	4.25	26.00
	8.48	5.99	16.31	7.74	56.91	4.57	28.00
1	8.59	6.61	15.63	9.12	55.99	4.06	25.00

'TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS.—*Continued.*	
	Bran from Winter Wheat.	
25387	Quality Mills, Enterprise, Kan.	*Danielson:* Young Bros. C
25235	Stanard Tilton Milling Co., St. Louis, Mo.	*New Haven:* R. G. Davis
25282	Vimco. Valley City Milling Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain
		Average of these 10 analyse
		Average digestible
	Bran from Spring Wheat.	
25349	Winona. Bay State Milling Co., Winona, Minn.	*Bristol:* G. W. Eaton Est.
25297	Clover Leaf. Seymour Carter, Gardner Mill, Hastings, Minn.	*Derby:* Peterson Hendee C
25386	Commander. Commander Mill Co., Minneapolis, Minn.	*Danielson:* Young Bros. Co
25383	Adrian. Detroit Milling Co., Detroit, Mich.	*Putnam:* F. M. Cole
25401	Imperial. Duluth Superior Mill Co., Duluth, Minn.	*Mystic:* J. L. Manning & C
25306	Eagle Roller Mill Co., New Ulm, Minn.	*Plainville:* G. W. Eaton E
25342	Ben Hur. Hennepin Mill Co., Minneapolis, Minn.	*Middletown:* Meech & Stod
25295	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Ansonia:* Flour & Grain Co
25226	Pillsbury's, Minneapolis, Minn.	*Bridgeport:* Berkshire Mills
25423	Sleepy Eye Mill Co., Sleepy Eye, Minn.	*E. Haven:* F. A. Forbes
24254	Coarse. Washburn-Crosby Co., Minneapolis, Minn.	*Springdale:* Monroe & Paln
25354	Western Canada Flour Mill Co.	*Hartford:* Smith Northam
25377	Black Hawk. Western Flour Mill Co., Davenport, Ia.	*Willimantic:* E. A. Buck &
		Average of these 13 analyse
		Average digestible
	Bran, unclassified.	
25294	A. B. P. Bran	*Ansonia:* Flour & Grain Co
25414	Badger. Berger Crittenden Mill. Co., Milwaukee, Wis.	*Winsted:* F. Woodruff & Sc
25224	C. M. C. Bran	*Bridgeport:* Standard Feed
25230	Lucky. Federal Milling Co., Lockport, N. Y.	*So. Norwalk:* Manuel T. H
25264	New Star Roller Mills, Math. Brann & Co., Wahpeton, No. Dak.	*Ridgefield:* S. D. Keeler
25268	Ogilvie's Bran	*Danbury:* F. C. Benjamin &
25379	Robin Hood. Saskatchewan Flour Mills Co.	*Colchester:* M. Klingon
25418	*U-Knead-It. Watson Mill Co., Wichita	*Winsted:* E. Manchester &
	Middlings from Winter Wheat.	
25371	Ballard's Ship Stuff. Ballard & Ballard, Louisville, Ky.	*Rockville:* Edward White
25317	The Gwinn Milling Co., Columbus, O.	*Meriden:* Grain & Feed Co
25220	"H." Hecker-Jones-Jewell Mill. Co., New York	*Bridgeport:* Vincent Bros.
25283	Vimco Choice. Valley City Mill. Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain
25352	Star. Western Star Mill Co., Salina, Kan.	*Hartford:* L. C. Daniels G Co.
		Average of these 5 analyses
		Average digestible

* Bran and Screenings.

SAMPLED IN 1910—*Continued.*

Pounds per Hundred.						
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
8.32	7.16	15.81	9.65	54.74	4.32	$25.00
9.92	6.73	17.00	8.32	53.49	4.54	25.00
9.46	6.24	15.19	8.03	56.51	4.57	28.00
8.90	**6.57**	**16.04**	**9.10**	**54.87**	**4.52**	**26.60**
----	---	**12.4**	**3.5**	**39.0**	**2.8**	-----
9.54	6.13	16.31	9.88	52.77	5.37	27.00
9.11	6.95	15.94	9.26	53.99	4.75	25.00
7.64	7.04	14.88	11.44	54.08	4.92	25.00
9.78	6.10	16.31	7.88	55.29	4.64	25.00
8.50	6.12	16.50	10.10	54.10	4.68	26.00
9.03	6.71	16.00	10.07	52.07	5.22	27.00
9.62	6.12	16.06	9.60	53.38	5.22	27.00
8.84	6.86	16.25	9.89	53.29	4.87	28.00
9.04	6.84	15.81	10.10	53.42	4.79	27.00
9.16	6.64	16.75	10.19	52.39	4.87	25.00
10.01	6.75	15.06	10.48	52.72	4.98	27.00
8.96	5.69	17.00	9.27	54.11	4.97	28.00
9.06	6.13	15.75	9.73	54.96	4.37	25.00
9.10	**6.47**	**16.05**	**9.91**	**53.57**	**4.90**	**26.31**
----	----	**12.4**	**3.9**	**38.0**	**3.1**	-----
9.84	5.98	17.06	9.09	52.62	5.41	28.00
9.61	6.15	16.44	8.68	54.40	4.72	28.00
9.35	6.87	17.50	8.65	52.51	5.12	28.00
9.00	6.79	15.88	9.00	54.67	4.66	28.00
8.95	6.76	16.00	11.18	52.41	4.70	29.00
10.76	6.51	16.31	10.03	51.08	5.31	26.00
7.97	6.40	16.44	9.98	53.44	5.77	25.00
9.68	6.31	17.38	8.43	53.58	4.62	26.00
9.69	4.39	18.13	5.41	57.68	4.70	30.00
10.09	4.05	20.44	4.96	55.58	4.88	26.00
10.09	5.30	17.69	7.94	53.85	5.13	27.00
9.94	4.17	16.44	4.87	59.53	5.05	30.00
10.85	3.40	17.75	3.48	60.25	4.27	34.00
10.13	**4.26**	**18.09**	**5.33**	**57.38**	**4.81**	**29.40**
----	----	**13.9**	**1.6**	**44.8**	**4.2**	-----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	WHEAT PRODUCTS.	
	Middlings from Spring Wheat.	
25363	No. 8. Chapin & Co., Milwaukee, Wis.	*Suffield:* Spencer Bros.
25392	Flour. Wm. G. Crocker, Minneapolis, Minn.	*Danielson:* Quinebaug Mill
25402	"S." Duluth Superior Mill. Co., Duluth, Minn.	*Mystic:* J. L. Manning & C
25307	Eagle Roller Mill Co., New Ulm, Minn.	*Plainville:* G. W. Eaton Es
25350	" " " " " " "	*Bristol:* W. O. Goodsell
25396	Lucky. Federal Milling Co., Lockport, N. Y.	*Yantic:* A. R. Manning
25293	Madelia Roller Mills, C. S. Christensen Co., Madelia, Minn.	*Ansonia:* Flour & Grain Co
25346	Meech & Stoddard, Middletown	*Middletown:* Meech & Stod
25395	National Milling Co., Toledo, O.	*Yantic:* A. R. Manning
25422	Fancy. Northwestern Milling Co., Little Falls, Minn.	*E. Haven:* F. A. Forbes
25250	Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Branford:* S. V. Osborn
25276	Pillsbury's A Middlings, Minneapolis, Minn.	*New Milford:* F. R. Green
25249	" B " " "	*Branford:* S. V. Osborn
25229	" XX Daisy, Minneapolis, Minn.	*Norwalk:* Holmes, Keeler & leck Co.
25359	" Daisy Middlings, Minneapolis, Minn.	*Thompsonville:* H. K. Brai
25253	Adrian. Washburn-Crosby Co., Minneapolis, Minn.	*Springdale:* Monroe & Palm
25255	Standard. Washburn-Crosby Co., Mineapolis, Minn.	*Springdale:* Monroe & Palm
25390	No tags	*Danielson:* Quinebaug Mill
		Average of these 18 analyse
		Average digestible
	Middlings, unclassified.	
25298	Flour. Banner Milling Co., Buffalo, N, Y.	*Derby:* Peterson Hendee Co
25409	Dexter. Chapin & Co., Milwaukee, Wis.	*Simsbury:* R. H. Ensign
25361	Wirthmore. Chas. M. Cox Co., Boston, Mass.	*Suffield:* Arthur Sikes
25225	Mapleleaf Mill Co., Canada	*Bridgeport:* Berkshire Mills
25330	*"Colonial." Miner-Hilliard Mill Co., Wilkesbarre, Pa.	*New Britain:* C. W. Lines
25312	Standard. Russell Miller Milling Co.	*Wallingford:* Gallagher Bro
	Mixed Feed from Winter Wheat.	
25289	Erie. Chapin & Co., St. Louis, Mo.	*Waterbury:* D. E. Dickinso Son
25356	Huron. Chapin & Co., Milwaukee, Wis.	*Hartford:* G. M. White Co.
25310	Manhattan. Hecker-Jones-Jewell Mill. Co., New York	*No. Haven:* Coöperative F Co.
25245	Queen. Hecker-Jones-Jewell Mill. Co., New York	*New Haven:* Abner Hendee
25415	Sunshine. Hunter-Robinson-Wenz Co., St. Louis, Mo.	*Winsted:* F. Woodruff & So
25325	Wild Fire. Hunter-Robinson-Wenz Co., St. Louis, Mo.	*Meriden:* A Grulick

* See page 622.

SAMPLED IN 1910—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
25363	9.56	3.92	17.88	4.96	58.23	5.45	$34.00
25392	9.89	4.19	18.63	5.79	55.70	5.80	32.00
25402	9.29	4.60	18.25	6.50	56.28	5.08	27.00
27307	9.39	5.15	17.69	8.46	53.87	5.44	30.00
25350	9.17	5.23	17.00	9.11	54.03	5.46	29.00
25396	9.10	4.47	18.50	6.64	55.84	5.45	29.00
25293	10.27	4.77	17.06	7.07	55.43	5.40	30.00
25346	9.80	4.80	17.94	7.99	53.95	5.52	27.00
25395	9.46	4.76	18.56	7.40	53.67	6.15	28.00
25422	9.22	4.72	17.81	8.15	54.67	5.43	28.00
25250	9.42	5.34	16.00	10.00	52.65	6.59	30.00
25276	10.71	3.93	17.81	4.71	58.23	4.61	30.00
25249	9.34	5.07	16.00	10.52	53.65	5.42	29.00
25229	11.04	3.47	18.50	2.49	60.43	4.07	32.00
25359	11.05	3.44	18.94	2.87	59.13	4.57	31.00
25253	11.14	2.96	18.13	2.68	60.81	4.28	33.00
25255	10.33	4.42	18.44	7.33	54.18	5.30	30.00
25390	8.83	4.87	17.44	7.37	55.51	5.98	28.00
----	**9.83**	**4.45**	**17.81**	**6.67**	**55.91**	**5.33**	**29.87**
----	----	----	**13.7**	**2.0**	**43.6**	**4.7**	----
25298	10.18	3.94	17.56	6.12	57.35	4.85	30.00
25409	9.83	4.32	17.69	5.91	56.72	5.53	30.00
25361	10.48	4.05	17.19	5.60	58.01	4.67	34.00
25225	8.79	4.99	18.19	8.03	53.98	6.02	29.00
25330	10.05	3.22	13.25	3.68	64.37	5.43	29.00
25312	9.61	4.78	17.56	7.47	54.85	5.73	28.00
25289	9.98	5.97	18.31	8.14	53.33	4.27	27.00
25356	9.22	4.73	16.94	6.57	58.15	4.39	31.00
25310	9.33	5.69	17.06	8.44	54.30	5.18	27.00
25245	10.16	6.10	16.38	10.71	51.80	4.85	28.00
25415	8.84	5.71	16.88	7.37	56.60	4.60	29.00
25325	9.56	5.62	17.06	6.98	56.13	4.65	28.00

*Table III.—Analyses of Commercial Feeds

Station No.	Brand.	Retail Dealer.
	Wheat Products.—*Concluded.*	
	Mixed Feed from Winter Wheat.	
25399	Kehlor Flour Mill Co., St. Louis, Mo.	*Westerly:* C. W. Campbell
25300	Anchor. Kemper Mill and Elev. Co., Kansas City, Mo.	*Hamden:* I. W. Beers
25272	Crescent. Kemper Mill and Elev. Co., Kansas City, Mo.	*New Milford:* G. T. Soule
25355	Snowflake. Lawrenceburg Roller Mill Co., Lawrenceburg, Ind.	*Hartford:* G. M. White Co.
25419	Wabash. Sparks Milling Co., Terre Haute, Ind.	*Winsted:* E. Manchester & S
25281	Cow. Valley City Mill. Co., Grand Rapids, Mich.	*Waterbury:* Spencer Grain
25388	Farmers' Favorite Cow. Valley City Mill. Co., Grand Rapids, Mich.	*Danielson:* Quinebaug Mill
25374	Waggoner-Gates Mill. Co., Independence, Ind.	*Willimantic:* H. A. Bugbee
25271	Kent. Williams Bros. Co., Kent, O.	*Danbury:* O. H. Meeker
		Average of these 15 analyse
		Average digestible
	Mixed Feed from Spring Wheat.	
25326	White Satin. Barber Mill. Co., Minneapolis, Minn.	*Meriden:* A. Grulick
25348	Winona. Bay State Mill. Co., Winona, Minn.	*Bristol:* G. W. Eaton Est.
25411	Rutland. Chapin & Co., Milwaukee, Wis.	*Torrington:* D. L. Talcott
25398	Vermont. " " " "	*Norwich:* Chas. Slosberg
25267	Claro. Claro Mill. Co., Lakeville, Minn.	*Danbury:* Keeler Grain Co.
25364	Boston. Duluth Superior Mill. Co., Duluth, Minn.	*Manchester:* G. W. Kuhney
25275	Lucky. Federal Mill. Co., Lockport, N. Y.	*New Milford:* F. R. Green
25273	Fancy. Pillsbury, Minneapolis, Minn.	*New Milford:* G. T. Soule
25269	Accident. Russell Roller Mill Co., Minneapolis, Minn.	*Danbury:* F. C. Benjamin &
25329	Gold Mine. Sheffield King Mill. Co., Minneapolis, Minn.	*New Britain:* C. W. Lines (
25337	Superior. Washburn-Crosby Co., Minneapolis, Minn.	*Guilford:* G. F. Walter
25301	Webster Mill Co., Webster, So. Dak.	*Hamden:* I. W. Beers
		Average of these 12 analyses
		Average digestible
	Mixed Feed, unclassified.	
25239	Bull's Eye. Blish Mill. Co., Seymour, Ind.	*New Haven:* R. G. Davis
25311	Regent. Charles M. Cox Co., Boston	*No. Haven:* Coöperative F Co.
25332	Wirthmore. " " " "	*New Britain:* C. W. Lines (
25279	Delmar. National Feed Co., St. Louis, Mo.	*Bethel:* Johnston & Morriso
25305	Buckeye. Quaker Oats Co., Chicago	*Plainville:* F. B. Newton
	Maize Products.	
	Gluten Feed.	
25343	Atlantic. Atlantic Starch Works, Westport	*Middletown:* Meech & Stodc
		Guaranty
		Digestible
25218	*Buffalo. Corn Products Refining Co., New York	*Bridgeport:* Vincent Bros.
25278	* " " " " " " "	*New Milford:* F. R. Green

SAMPLED IN 1910—*Continued*.

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
25399	8.79	6.12	17.38	8.16	54.77	4.78	$27.00
25300	8.88	5.79	17.31	7.49	55.97	4.56	26.50
25272	9.71	5.75	17.25	7.35	55.58	4.36	27.00
25355	9.40	5.30	16.94	7.11	56.84	4.41	30.00
25419	9.56	4.85	16.94	6.71	57.81	4.13	27.00
25281	9.62	5.50	16.88	6.37	57.11	4.52	30.00
25388	9.16	5.32	16.19	7.14	57.67	4.52	31.00
25374	8.36	5.91	17.19	7.48	56.42	4.64	28.00
25271	9.43	5.05	16.69	5.85	58.76	4.22	29.00
-----	**9.33**	**5.56**	**17.03**	**7.46**	**56.08**	**4.54**	**28.37**
-----	----	----	**13.3**	**4.6**	**43.2**	**3.9**	-----
25326	9.20	4.91	17.81	6.94	55.98	5.16	29.00
25348	9.68	5.74	17.13	8.54	53.70	5.21	30.00
25411	8.93	5.26	17.44	8.44	54.27	5.66	28.00
25398	9.90	5.06	17.13	7.00	56.10	4.81	29.00
25267	9.98	5.50	17.13	8.67	53.88	4.84	29.00
25364	8.80	5.31	17.75	7.47	55.69	4.98	28.00
25275	9.32	5.86	16.94	9.21	53.47	5.20	29.00
25273	10.37	4.66	17.06	5.87	57.71	4.33	30.00
25269	9.93	5.09	17.94	7.70	54.33	5.01	28.00
25329	8.96	5.33	16.88	7.09	56.67	5.07	29.00
25337	9.57	4.84	16.44	7.01	57.25	4.89	28.00
25301	8.56	5.68	16.56	8.88	55.08	5.24	26.50
-----	**9.43**	**5.27**	**17.18**	**7.74**	**55.35**	**5.03**	**28.63**
-----	----	----	**13.4**	**4.8**	**42.6**	**4.4**	-----
25239	10.93	5.67	15.75	7.49	55.96	4.20	26.00
25311	9.06	5.17	16.69	7.43	56.44	5.21	26.00
25332	8.92	4.68	17.50	6.09	57.97	4.84	30.00
25279	9.89	5.75	16.88	7.20	55.84	4.44	26.00
25305	9.37	4.03	16.56	6.80	58.83	4.41	28.00
25343	7.20	0.96	32.00	1.03	58.32	0.49	32.00
-----	----	----	**28.00**	----	----	**1.00**	-----
-----	----	----	**27.2**	**0.8**	**51.9**	**0.4**	-----
25218	9.57	4.00	23.88	5.72	54.19	2.64	29.00
25278	9.32	5.48	26.94	6.58	49.87	1.81	28.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MAIZE PRODUCTS.—*Continued.*	
	Gluten Feed.	
25420	*Buffalo. Corn Products Refining Co., New York	*Canaan:* Ives & Pierce
		Average guaranty
		Average of these 3 analyses
		Average digestible
25351	Cedar Rapids. Douglas & Co., Cedar Rapids, Ia.	*Bristol:* W. O. Goodsell
25367	" " " " " " "	*Manchester:* G. W. Kuhney
		Average guaranty
		Average of these 2 analyses
		Average digestible
25257	*Cream of Corn. American Maize Products Co., New York	*Stamford:* W. L. Crabb
25324	*Cream of Corn. American Maize Products Co., Roby, Ind.	*Meriden:* A. Grulick
25424	*Cream of Corn. American Maize Products Co., Roby, Ind.	*Westville:* W. E. Warner & Br
		Average guaranty
		Average of these 3 analyses
		Average digestible
25274	*Crescent. Corn Products Refining Co., New York	*New Milford:* L. Wischert
25341	*Crescent. Corn Products Refining Co., New York	*Middletown:* Meech & Stodda
		Average guaranty
		Average of these 2 analyses
		Average digestible
25241	*Globe. Corn Products Refining Co., New York	*New Haven:* R. G. Davis
25338	* " " " " " " "	*Guilford:* G. F. Walter
25384	* " " " " " " "	*Putnam:* Bosworth Bros.
		Average guaranty
		Average of these 3 analyses
		Average digestible
25344	Gluten Feed. Meech & Stoddard, Middeltown	*Middletown:* Meech & Stodda
		Guaranty
		Digestible
	Hominy Feed.	
25313	Homco. American Hominy Co., Indianapolis, Ind.	*Wallingford:* Gallagher Bros.
		Guaranty
25256	Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb
		Guaranty
25304	Wirthmore. Chas. M. Cox Co., Boston	*Plainville:* F. B. Newton
25227	" " " " "	*Norwalk:* Holmes, Keeler Selleck Co.
		Average guaranty
		Average of these 2 analyses
25369	Success. Deutsch & Sickert Co., Milwaukee, Wis.	*Rockville:* Rockville Mill. Co.
		Guaranty
25221	Yellow. Husted Mill Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Cc
		Guaranty

Sampled in 1910—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
25420	9.83	5.51	25.50	6.49	49.02	3.65	$30.00
----	----	----	**24.00**	----	----	**2.50**	----
----	**9.57**	**5.00**	**25.44**	**6.26**	**51.03**	**2.70**	**29.00**
----	----	----	**21.6**	**4.8**	**45.4**	**2.2**	----
25351	7.12	1.21	20.00	6.12	58.42	7.13	29.00
25367	7.00	1.21	20.19	6.71	56.93	7.96	28.00
----	---	----	**22.00**	----	----	**3.25**	----
----	**7.06**	**1.21**	**20.10**	**6.41**	**57.67**	**7.55**	**28.50**
----	----	----	**17.1**	**4.9**	**51.3**	**6.3**	----
25257	7.33	2.66	25.69	6.51	54.39	3.42	33.00
25324	8.39	3.64	25.75	6.21	52.06	3.95	29.00
25424	8.82	3.01	24.31	6.67	52.14	5.05	28.00
----	----	----	**23.00**	----	----	**2.50**	----
----	**8.18**	**3.10**	**25.25**	**6.46**	**52.87**	**4.14**	**30.00**
----	----	----	**21.5**	**4.9**	**47.1**	**3.4**	----
25274	8.97	3.84	24.69	7.10	50.51	4.89	29.00
25341	8.07	4.68	26.38	5.94	53.15	1.78	27.50
----	----	----	**24.00**	----	----	**2.50**	----
----	**8.52**	**4.26**	**25.54**	**6.52**	**51.82**	**3.34**	**28.25**
----	----	----	**21.7**	**5.0**	**46.1**	**2.8**	----
25241	9.34	3.67	26.81	5.56	52.05	2.57	29.00
25338	9.16	5.09	27.13	6.48	50.17	1.97	28.00
25384	6.57	5.05	27.56	6.82	51.72	2.28	28.00
----	----	----	**24.00**	----	----	**2.50**	----
----	**8.36**	**4.60**	**27.17**	**6.29**	**51.31**	**2.27**	**28.33**
----	----	----	**23.1**	**4.8**	**45.7**	**1.9**	---
25344	5.74	0.87	18.63	6.47	63.15	5.14	27.50
----	----	----	**22.00**	...	----	**4.00**	----
----	----	----	**15.8**	**4.9**	**56.2**	**4.3**	----
25313	8.91	2.54	10.56	3.50	66.84	7.65	28.00
----	----	----	**8.50**	----	----	**7.00**	----
25256	9.84	2.19	8.88	3.19	68.94	6.96	28.00
----	----	----	**10.00**	----	----	**7.00**	----
25304	8.80	2.65	10.31	4.29	65.59	8.36	30.00
25227	9.33	2.56	9.88	3.87	66.86	7.50	28.00
----	----	----	**10.00**	----	----	**7.50**	----
----	**9.06**	**2.60**	**10.10**	**4.08**	**66.23**	**7.93**	**29.00**
25369	7.34	3.07	10.88	5.07	65.19	8.45	29.00
----	----	----	**11.00**	----	----	**7.00**	----
25221	9.49	2.22	9.69	3.30	68.67	6.63	29.00
----	----	----	**9.00**	----	----	**6.00**	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MAIZE PRODUCTS.—*Continued.* *Hominy Feed.*	
25265	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Thomaston:* L. E. Belmer
25314	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Wallingford:* E. E. Hall
25413	Steam Cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa.	*Litchfield:* Litchfield Grain C
		Guaranty
		Average of these 3 analyses
25407	The Patent Cereal Co., Geneva, N. Y.	*Collinsville:* Collinsville Gr Co.
		Guaranty
25252	Wm. H. Payne & Son, New York	*New Canaan:* C. H. Fairty
		Guaranty
25266	Yellow. Quaker Oats Co., Chicago	*Danbury:* Keeler Grain Co.
25406	Blue Ribbon. J. E. Soper & Co., Boston, Mass.	*New London:* P. Schwartz C
		Guaranty
		Average guar'ty all hominy fee
		Average of all (13) analyses
		Average digestible
25263	Star Feed. Toledo Elevator Co., Toledo, O.	*Ridgefield:* S. D. Keeler
25339	" " " " " " "	*Guilford:* Morse & Landon
		Average guaranty
		Average of these 2 analyses
		Average digestible
	Corn Meal.	
25403	Ground by J. L. Manning & Co., Mystic	Digestible
	RYE PRODUCTS. *Rye Middlings.*	
25247	The Boutwell Mill. & Grain Co., Troy, N. Y.	*New Haven:* Abner Hendee
25219	Hecker-Jones-Jewell Mill. Co., New York	*Bridgeport:* Vincent Bros.
25292	Miner-Hillard Mill. Co., Wilkesbarre, Pa.	*Ansonia:* Flour & Grain Co.
25412	Washburn-Crosby Co., Minneapolis, Minn.	*Torrington:* D. L. Talcott
		Average of these 4 analyses
	BUCKWHEAT PRODUCTS. *Buckwheat Middlings.*	
25369	Ground by Quinebaug Mills, Danielson	Digestible
	BARLEY PRODUCTS. *Malt Sprouts.*	
25244	Atlantic Export Co., Chicago	*New Haven:* Abner Hendee
		Guaranty
25238	The C. Zwickel Malting Co., Buffalo, N. Y.	*New Haven:* R. G. Davis
		Guaranty
		Average of these 2 analyses
		Average digestible

SAMPLED IN 1910—*Continued.*

Station No.	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	POUNDS PER HUNDRED.						
85	9.45	2.59	10.19	4.22	65.16	8.39	$28.00
14	8.95	2.59	10.31	4.54	65.33	8.28	25.00
13	8.55	2.85	10.44	4.72	64.40	9.04	29.00
---	---	---	**10.00**	----	-----	**7.50**	----
---	**8.98**	**2.68**	**10.31**	**4.49**	**64.97**	**8.57**	----
07	9.21	2.54	10.31	4.07	65.92	7.95	28.00
---	----	----	**10.00**	----	-----	**7.00**	----
52	8.26	2.64	10.44	3.93	66.71	8.02	27.00
	----	----	**11.00**	----	-----	**8.00**	----
66	9.48	2.12	9.50	3.36	69.47	6.07	28.00
06	8.68	2.56	10.31	4.06	66.51	7.88	26.00
--	----	----	**10.00**	----	-----	**8.00**	----
--	----	----	**9.96**	----	-----	**7.29**	----
--	**8.95**	**2.55**	**10.13**	**4.01**	**66.58**	**7.78**	**27.92**
--	----	---	**6.6**	**2.7**	**59.3**	**7.2**	----
63	8.26	3.55	9.31	10.14	62.64	6.10	* 29.00
39	8.37	2.85	8.19	11.23	63.62	5.74	26.00
---	----	----	**7.00**	----	-----	**5.50**	----
--	**8.32**	**3.20**	**8.75**	**10.68**	**63.13**	**5.92**	**27.50**
--	----	----	**5.7**	**7.2**	**56.2**	**5.4**	----
03	11.78	1.30	8.19	1.88	72.89	3.96	26.00
--	----	----	**5.4**	----	**67.1**	**3.6**	-- -
47	10.59	3.81	16.19	4.42	61.38	3.61	28.50
19	9.74	3.90	16.00	3.87	63.06	3.43	27.00
92	10.45	3.22	15.44	3.56	64.15	3.18	30.00
12	8.44	4.85	16.19	5.59	60.99	3.94	30.00
--	**9.80**	**3.95**	**15.96**	**4.36**	**62.39**	**3.54**	**28.88**
89	10.09	4.78	29.56	10.63	37.59	7.35	32.00
--	----	----	**25.1**	**1.8**	**31.2**	**6.5**	----
44	10.74	6.08	25.69	12.53	43.15	1.81	26.00
--	----	----	**25.00**	----	-----	**1.50**	----
38	11.16	5.64	27.13	11.21	43.47	1.39	25.00
--	----	----	**25.00**	----	-----	**2.00**	----
--	**10.95**	**5.86**	**26.41**	**11.87**	**43.31**	**1.60**	**25.50**
--	----	----	**21.1**	**4.0**	**29.9**	**1.6**	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	BARLEY PRODUCTS.—*Concluded.*	
	Dried Brewers' Grains.	
25362	Pilsner. Rosekhaus Snyder Co., Philadelphia, Pa.	*Suffield:* Arthur Sikes
		Guaranty
		Digestible
	Dried Distillers' Grains.	
25358	Ajax Flakes. Ajax Mill. and Feed Co., Buffalo, N. Y.	*Thompsonville:* H. K. Br
		Guaranty
		Digestible
25345	Dearborn Distillers' Grains. The J. W. Biles Co., Cincinnati, O.	*Middletown:* Meech & Sto
		Guaranty
		Digestible
	MIXED FEEDS.	
	Corn and Oat Feeds and Oat Feeds.	
25284	Buffalo Cereal Co., Chop Feeds. Buffalo Cereal Co., Buffalo, N. Y.	*Thomaston:* L. E. Belmer
		Guaranty
25380	Oat Feed. Chas. M. Cox Co., Boston, Mass.	*Colchester:* M. Klingon
		Guaranty
25288	Adrian Chop Feed. Detroit Mill. Co., Detroit, Mich.	*Waterbury:* D. L. Dickins Son
		Guaranty
25340	Oat Feed. Dow Cereal and Mill. Co., Pilot Mound, Manitoba	*Guilford:* Morse & Lando
25243	Boss Feed. The Great Western Cereal Co., Chicago	*New Haven:* Abner Hende
		Guaranty
25315	Provender	*Wallingford:* E. E. Hall
25265	Jim Dandy Feed. The H. O. Co., Buffalo, N. Y.	*Danbury:* Keeler Grain Co
		Guaranty
25242	Corn and Oats. Husted Mill. Co., Buffalo, N. Y.	*New Haven:* R. G. Davis
25277	" " " " " " "	*New Milford:* F. R. Green
		Average guaranty
		Average of these 2 analyses
25320	Imperial Feed. Imperial Grain and Mill. Co., Toledo, O.	*Meriden:* Grain & Feed Co
		Guaranty
25347	Korn-Oato. Meech & Stoddard, Middletown	*Middletown:* Meech & Stod
		Guaranty
25232	Victor Feed. Quaker Oats Co., Chicago	*New Haven:* J. T. Benham
		Guaranty
		Average of these 12 analys
		Average digestible
	Wheat and Corn Cob Feeds.	
25262	Holstein Mixed Feed. Indiana Mill. Co., Terre Haute, Ind.	*Greenwich:* J. P. Johnson
		Guaranty

SAMPLED IN 1910—*Continued.*

	Pounds Per Hundred.						
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
)2	5.87	3.06	29.50	13.57	40.43	7.57	27.00
..	----	----	25.00	----	---	5.00	----
..	----	----	23.9	6.6	23.0	6.7	---
;8	5.63	2.02	30.81	11.60	36.84	13.10	33.50
..	----	----	30.00	----	----	11.00	----
..	----	----	22.5	11.0	29.8	12.4	----
15	6.33	1.93	24.81	12.44	44.96	9.53	28.50
..	----	----	22.00	----	----	8.00	----
..	----	----	18.1	11.8	36.4	9.1	----
34	8.64	3.42	8.31	10.26	64.89	4.48	29.00
	----	----	7.00	----	----	3.00	----
)0	6.28	6.38	4.75	27.10	53.35	2.14	23.00
..	----	----	6.00	----	----	2.00	----
38	7.97	3.15	8.69	7.47	66.81	5.91	30.00
..	----	----	8.50	----	----	5.00	----
10	6.72	6.00	6.50	24.91	53.68	2.19	25.00
13	8.13	5.27	8.13	10.16	63.94	4.37	26.00
..	----	----	8.00	----	----	3.00	----
(5	8.02	3.96	7.00	15.08	62.32	3.62	25.00
)5	6.78	5.84	6.56	25.33	52.72	2.77	25.00
..	----	----	7.50	----	----	2.75	----
12	10.87	1.94	9.19	3.93	70.25	3.82	34.00
77	9.51	3.41	9.94	5.14	65.62	6.38	29.00
..	----	----	9.00	----	----	4.00	----
..	10.19	2.68	9.57	4.53	67.93	5.10	31.50
20	8.44	1.83	10.25	3.66	71.56	4.26	38.00
..	----	----	10.00	----	----	4.50	----
17	7.55	3.32	7.06	13.48	66.24	2.35	26.00
..	----	----	7.00	----	----	3.00	----
32	8.99	2.85	7.94	8.77	68.04	3.41	26.00
..	----	----	7.50	----	----	3.00	----
..	8.16	3.95	7.86	12.94	63.28	3.81	28.00
..	----	----	5.6	6.2	52.5	3.3	----
)2	9.02	4.72	11.75	17.70	53.53	3.28	26.00
..	----	---	13.00	---	----	3.50	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS—*Continued.* *Wheat and Corn Cob Feeds.*	
25233	Jersey Mixed Feed. Indiana Mill Co., Terre Haute, Ind.	*New Haven:* J. T. Benham Es
25270	Jersey Mixed Feed. Indiana Mill Co., Terre Haute, Ind.	*Danbury:* F. C. Benjamin & C
		Average guaranty
25416	Blue Grass Mixed Feed. A. Waller & Co., Henderson, Ky.	*Winsted:* Theo. Wachter
		Guaranty
		Average of these 4 analyses
		Average digestible
	Proprietary Horse Feeds.	
25286	Sucrene Horse and Mule Feed. American Milling Co., Chicago	*Thomaston:* L. E. Belmer
		Guaranty
25258	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb
		Guaranty
25231	Bonnie Horse Feed	*So. Norwalk:* Manuel T. Hate
		Guaranty
25331	Algrane Horse Feed. The H. O. Co., Buffalo, N. Y.	*New Britain:* C. W. Lines Co.
		Guaranty
25410	Sugarota Horse Feed. North West Mills Co., Winona, Minn.	*Torrington:* F. U. Wadhams
		Guaranty
25405	Schumacher's Special Horse Feed. Quaker Oats Co., Chicago	*New London:* P. Schwartz Co
		Guaranty
	Proprietary Dairy and Stock Feeds.	
25287	Sucrene Dairy Feed. American Milling Co., Chicago	*Thomaston:* L. E. Belmer
		Guaranty
25251	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*New Canaan:* C. H. Fairty
25291	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Waterbury:* D. L. Dickinson Son
		Guaranty
		Average of these 2 analyses
25376	Calf Meal. Blatchford's Calf Meal Fact., Waukegan, Ill.	*Willimantic:* H. A. Bugbee
		Guaranty
25240	Unicorn Dairy Ration. Chapin & Co., Buffalo, N. Y.	*New Haven:* R. G. Davis
25280	Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*Bethel:* Johnston & Morrison
		Guaranty
		Average of these 2 analyses

SAMPLED IN 1910—*Continued.*

Station No.	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Pounds per Hundred.						
25233	9.19	5.15	11.69	16.10	54.71	3.16	$23.00
25270	9.12	5.11	11.88	15.27	55.03	3.59	23.00
----	----	----	**12.00**	----	----	**3.00**	----
25416	8.98	3.99	12.31	15.47	56.32	2.93	27.00
----	----	----	**9.00**	----	----	**2.00**	----
----	**9.08**	**4.74**	**11.91**	**16.14**	**54.89**	**3.24**	**24.75**
----	----	----	**7.5**	**4.5**	**39.0**	**3.0**	----
25286	9.73	7.59	11.63	10.64	56.65	3.76	30.00
----	----	----	**10.00**	----	----	**3.00**	----
25258	8.87	3.42	12.19	8.51	61.62	5.39	31.00
----	----	----	**10.00**	----	----	**4.00**	----
25231	9.63	2.87	10.75	8.02	64.78	3.95	31.00
----	----	----	**14.00**	----	----	**4.00**	----
25331	7.65	4.02	10.63	10.10	62.91	4.69	30.00
----	----	----	**12.00**	----	----	**4.50**	----
25410	9.45	6.58	10.81	16.19	53.51	3.46	32.00
----	----	----	**12.00**	----	----	**3.00**	----
25405	8.06	3.12	9.00	9.02	66.50	4.30	29.00
----	----	----	**9.00**	----	----	**3.00**	----
25287	8.75	7.72	15.63	12.78	51.87	3.25	29.00
----	----	----	**16.50**	----	----	**3.50**	----
25251	7.80	4.51	24.25	8.83	46.27	8.34	34.00
25291	7.72	5.08	24.31	9.43	46.23	7.23	34.00
----	----	----	**24.00**	----	----	**7.00**	----
----	**7.76**	**4.79**	**24.28**	**9.13**	**46.25**	**7.79**	**34.00**
25376	9.32	5.36	28.13	5.26	46.76	5.17	70.00
----	----	----	**25.00**	----	----	**5.00**	----
25240	7.91	3.39	24.50	9.52	46.62	8.06	32.00
25280	7.68	4.38	25.13	8.82	47.05	6.94	33.00
----	----	----	**26.00**	----	----	**5.50**	----
----	**7.80**	**3.88**	**24.82**	**9.17**	**46.83**	**7.50**	**32.50**

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS—*Continued.* *Proprietary Dairy and Stock Feeds.*	
25318	Wirthmore Stock Feed. Chas. M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed Co.
		Guaranty
25353	White Cross Stock Feed. Albert Dickinson Co., Chicago	*Hartford:* Smith Northam C
		Guaranty
25366	Daisy Dairy Feed. The Great Western Cereal Co., Chicago	*Manchester:* G. W. Kuhney.
		Guaranty
25365	Gregson Calf Meal. The Great Western Cereal Co., Chicago	*Manchester:* G. W. Kuhney.
		Guaranty
25327	Sterling Stock Feed. The Great Western Cereal Co., Chicago	*Meriden:* A. Grulick
		Guaranty
25397	Stock Feed. W. H. Haskell & Co., Toledo, O.	*Norwich:* Chas. Slosberg
		Guaranty
25223	Algrane Milk Feed. The H. O. Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed
		Guaranty
25308	New England Stock Feed. The H. O. Co., Buffalo, N. Y.	*Plainville:* G. W. Eaton Est.
		Guaranty
25260	Husted Dairy Feed. Husted Mill. Co., Buffalo, N. Y.	*Stamford:* H. S. Bellinger
		Guaranty
25259	Mayflower Stock Feed. Husted Mill. Co., Buffalo, N. Y.	*Stamford:* H. S. Bellinger
		Guaranty
25222	Zenith Stock Feed. Husted Mill Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed
		Guaranty
25328	Badger Dairy Feed. Chas. A. Krause Mill Co., Milwaukee, Wis.	*Meriden:* A. Grulick
		Guaranty
25360	Sugarota Calf Meal. North West Mills Co., Winona, Minn.	*Thompsonville:* H. K. Brain
		Guaranty
25334	Sugarota Milk Meal. North West Mills Co., Winona, Minn.	*New Britain:* Stanley Svea Gr Co.
25400	Sugarota Milk Meal. North West Mills Co., Winona, Minn.	*Westerly:* C. W. Campbell (
		Guaranty
		Average of these 2 analyses
25228	Sc humcher's Stock Feed. Quaker Oats Co., Chicago	*Norwalk:* Holmes, Keeler Selleck Co.
		Guaranty

SAMPLED IN 1910.

[illegible]	Pounds Per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
18	7.52	3.26	9.63	7.90	64.07	7.62	$32.00
--	----	----	**9.00**	----	----	**4.00**	----
53	9.66	2.12	10.00	4.09	69.99	4.14	31.00
--	----	----	**10.00**	----	----	**3.50**	----
56	6.15	7.65	15.50	14.33	54.19	2.18	28.00
--	----	----	**15.00**	----	----	**3.00**	----
55	7.83	5.72	27.94	4.74	46.99	6.78	50.00
--	----	----	**25.00**	----	----	**5.00**	----
27	7.86	3.98	10.25	11.14	61.50	5.27	29.00
--	----	----	**10.00**	----	----	**4.00**	----
97	7.36	3.31	9.44	7.03	65.64	7.22	27.00
-	----	----	**8.00**	---	----	----	----
23	8.70	4.90	19.13	12.18	51.89	3.20	31.00
--	----	----	**14.00**	----	----	**4.00**	----
98	6.80	4.40	9.94	12.05	60.80	6.01	30.00
--	----	----	**9.00**	----	----	**4.00**	----
00	9.48	5.96	22.50	6.47	50.19	5.40	32.00
--	----	----	**20.00**	----	---	**4.00**	----
59	9.64	3.41	9.19	6.52	65.31	5.93	25.00
-	----	----	**7.50**	----	----	**3.50**	----
22	9.63	2.95	10.81	5.26	66.12	5.23	29.00
--	----	----	**10.00**	----	----	**4.00**	----
28	9.80	8.14	19.06	12.54	47.12	3.34	28.00
--	----	----	**16.00**	----	----	**3.50**	----
00	9.73	4.30	26.56	4.58	48.71	6.12	70.00
--	----	----	**25.00**	----	----	**6.00**	----
14	8.00	8.86	25.44	11.37	43.30	3.03	32.00
00	7.81	7.78	25.00	11.89	44.05	3.47	27.00
-	----	----	**25.00**	----	----	**6.00**	----
-	**7.90**	**8.32**	**25.22**	**11.63**	**43.68**	**3.25**	**29.50**
28	8.77	4.18	11.13	9.20	62.70	4.02	27.00
-	----	----	**10.00**	----	----	**3.25**	----

TABLE III.—ANALYSES OF COMMERCIAL FEEDS

Station No.	Brand.	Retail Dealer.
	MIXED FEEDS—*Concluded.* *Proprietary Dairy and Stock Feeds.*	
25299	Schumacher's Calf Meal. Quaker Oats Co., Chicago	*Hamden:* I. W. Beers Guaranty
25319	Wirthmore Balanced Ration Feed. St. Albans Grain Co., St. Albans, Vt.	*Meriden:* Grain & Feed C Guaranty
25290	Economy Feed. Tioga Mill and Elev. Co., Waverly, N. Y.	*Waterbury:* D. L. Dickin Son Guaranty
	Proprietary Poultry Feeds.	
25322	Wirthmore Growing Feed. Chas. M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed C Guaranty
25323	Wirthmore Poultry Mash. Charles M. Cox Co., Boston, Mass.	*Meriden:* Grain & Feed C Guaranty
25248	Algrane Poultry Feed. The H. O. Co., Buffalo, N. Y.	*New Haven:* Abner Hend Guaranty
25336	Poultry Feed. Husted Mill. Co., Buffalo, N. Y.	*New Britain:* Stanley Svea Co. Guaranty
25333	Sugarota Scratch Feed. North West Mills Co., Winona, Minn.	*New Britain:* Stanley Svea Co. Guaranty
25309	Dry Mash Feed. Park & Pollard Co., Boston, Mass.	*Plainville:* G. W. Eaton E Guaranty
25391	Growing Feed. Park & Pollard Co., Boston, Mass.	*Danielson:* Quinebaug Mil Guaranty
25335	American Poultry Feed. Quaker Oats Co., Chicago	*New Britain:* Stanley Svea Co. Guaranty
25217	Dry Mash. Vincent Bros., Bridgeport, Conn.	*Bridgeport:* Vincent Bros.

SAMPLED IN 1910—*Concluded.*

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
8.34	2.55	19.69	1.54	59.55	8.33	$31.00
----	----	**19.00**	----	-----	**8.00**	-----
8.79	4.46	26.31	8.21	46.78	5.45	32.00
----	----	**26.00**	----	-----	**5.00**	-----
7.54	3.01	10.94	14.32	59.88	4.31	27.00
----	----	**10.00**	----	-----	**5.00**	-----
10.95	1.96	12.94	2.91	68.15	3.09	38.00
----	----	**15.00**	----	-----	**5.00**	-----
9.33	3.87	13.94	8.23	60.25	4.38	38.00
----	----	**12.00**	----	-----	**3.00**	-----
9.68	3.78	15.88	7.03	58.78	4.85	37.00
----	----	**17.00**	----	-----	**5.50**	-----
10.25	3.93	14.88	7.03	59.72	4.19	39.00
----	----	**12.00**	----	-----	**4.00**	-----
10.32	1.53	10.25	1.98	71.88	4.04	39.00
----	----	**12.00**	----	-----	**3.50**	-----
8.83	13.61	23.19	4.01	47.19	3.17	45.00
----	----	**20.00**	----	-----	**3.00**	-----
10.20	6.85	13.50	2.58	62.85	4.02	44.00
----	----	**14.00**	----	-----	**3.00**	-----
9.14	3.19	12.81	4.81	63.88	6.17	39.00
----	----	**12.00**	----	-----	**3.00**	-----
9.00	9.19	21.50	10.02	45.49	4.80	35.00

The variations in the amounts of digestible fat supplied in the different groups are comparatively small, except in the third group. The differences in the other two food compounds, however, are marked. Protein is by far the more expensive of these two, more than one-sixth of it being nitrogen, the element most generally lacking in our soils, most expensive to buy in fertilizers, and most necessary to "balance" the feeding rations of our stock.

If the feeder is mainly concerned in getting protein for his grain feed, he certainly cannot afford to buy feeds of the last three groups containing less than 20 per cent. of protein. But even if he wishes to buy starchy food, he can get more for the same money in group three than in four, and nearly as much as in five. Considering that he gets from two to three times as much protein together with nearly the amount of carbohydrates in group three as in groups five and six, the economy of buying these very low protein foods even for the starchy matter in them is more than doubtful.

In this era of high prices practical economy demands that the feeder shall give the closest attention to the cost of the feeds he buys. The table shows that for prices ranging from $26 to $28 per ton he may buy feeds containing from 8.19 to 29.50 per cent. of protein. Again for $32 he may buy feeds ranging from 9.63 to 32.00 per cent. of protein. Failure to observe this lack of relation between cost and the needed nutriment supplied may explain why in many cases the dairy business is no longer profitable.

PART IX.

TENTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I hereby transmit my tenth annual report as state entomologist of Connecticut. The work has been conducted along the same lines as last year, and shows an increasing amount of inspection and control work, due chiefly to the discovery on December 14, 1909, of a gypsy moth colony at Wallingford; to the apiary inspection work imposed upon this office by the last General Assembly; and to the increase in the imports of nursery stock into the state.

The financial report is for the state fiscal year ending September 30th, but the remainder of the report covers the calendar year of 1910.

Respectfully submitted,

W. E. BRITTON,
State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1909, TO SEPTEMBER 30TH, 1910.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$3,000.00	
Account of 1908, balance	1,151.86	
Sale of lantern slides and electrotypes	3.65	
		$4,155.51

EXPENDITURES.

For field, office and laboratory assistance	$1,976
Printing and illustrations	354
Postage	51

Stationery	$ 8.50	
Telegraph and telephone	3.60	
Express, freight and cartage	39.24	
Library	171.50	
Laboratory apparatus and supplies	145.44	
Spraying supplies	14.35	
Office supplies	53.98	
Traveling expenses	244.55	
Balance, cash on hand	1,091.96	
		$4,155.51

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,150.00	
Account of 1909, balance	410.22	
		$4,560.22

EXPENDITURES.

For salary of superintendent, and labor	$3,725.66	
Printing	77.00	
Tools and supplies	498.42	
Express, freight, and cartage	30.58	
Traveling expenses	210.61	
Balance, cash on hand	17.95	
		$4,560.22

Memorandum:—This account of the state entomologist has been duly audited by the State Auditors of Public Accounts.

PUBLICATIONS BY THE ENTOMOLOGIST, 1910.

The Official Entomologist and the Farmer. *Journal of Economic Entomology,* Vol. III, p. 12. 8 pages.

Report of Committee on Injurious Insects, W. E. Britton, Chairman. Read at the annual meeting, February 3, 1910. Report of the Connecticut Pomological Society, 1910, p. 145. 4 pages.

Ninth Report of the State Entomologist (Part IV of the Station Report for 1909-1910); 52 pages, 9 text figures, 16 plates; 9,000 copies distributed in May, 1910.

Notes of the Season in Connecticut. *Journal of Economic Entomology,* Vol. III, p. 434. 2½ pages.

Spraying to Destroy the San José Scale in Connecticut. *The National Nurseryman,* March, 1910, p. 510.

The Gypsy Moth in Connecticut. *Guide to Nature,* June, 1910, p. 84. 2 pages. (Illustrated.)

The following articles were printed in the *Connecticut Farmer* under the dates given below:

White Grubs in Grass Lands. February 19, 1910.

Elm Leaf Beetle. April 2, 1910. (Also issued as a correspondence slip.)

Canker Worms. April 9, 1910. (Illustrated.)
Progress of the Gypsy Moth Work at Wallingford. April 9, 1910.
The Bud Moth *Tmetocera ocellana* Schiff. May 21, 1910.
Cutworms. June 4, 1910. (Also issued as a correspondence slip.)
Some of the More Important Insects Found in Connecticut. June 11, 1910. (Illustrated.)
The Maple Borer. July 9, 1910. (Illustrated.)
The Gypsy Moth Infestation at Wallingford. July 16, 1910. (Illustrated.)
A Pest of Birch Trees in Connecticut, *Bucculatrix canadensisella* Chamb. September 24, 1910.

DEPARTMENT STAFF.

W. E. BRITTON, PH.D.	*State and Station Entomologist.*
B. H. WALDEN, B.AGR.	*Assistant.*
DONALD J. CAFFREY, B.AGR.	*Assistant.*
ALFRED B. CHAMPLAIN	*Assistant.*
MISS E. B. WHITTLESEY	*Stenographer.*

Mr. G. H. Hollister, who for three years has had charge of the gypsy moth work, was appointed to a more lucrative position in Keney Park, Hartford, and left this department about October 15th, 1909. He is now foreman of Keney Park. Mr. Donald J. Caffrey, a graduate of the Massachusetts Agricultural College, was secured and took charge, on January 24th, of the gypsy moth work at Wallingford, which was continued until the last of August, when Mr. Caffrey was transferred to the work of inspecting nurseries until November 1st, when he returned to the gypsy moth work.

Mr. Alfred B. Champlain, formerly of the laboratory of the Economic Zoölogist at Harrisburg, began his duties as assistant April 1st. He has assisted in the inspection of imported nursery stock and of the Connecticut nurseries, and has made a number of charts and drawings and done considerable work on the insect collection, as he is a specialist in the family Carabidæ of the beetles.

Mr. B. H. Walden has continued as general assistant, and has had charge of the work of the office in my absence. He has also done most of the photographic work of the department. Miss Elizabeth B. Whittlesey has also continued her work as stenographer, assisting each morning in the correspondence and the necessary indexing and filing of the office. During her

absence Miss K. E. Flynn and Miss M. K. Falsey were each employed for a short time. All of the persons mentioned have rendered satisfactory services, and their work is appreciated.

Chief Lines of Work.

The work of this department has been conducted along lines similar to that of last year, and shows an increased amount of inspection and control work, due principally to the discovery on December 14th, 1910, of a gypsy moth colony at Wallingford; to the apiary inspection imposed upon this office by the last General Assembly, and to the increase in the imports of nursery stock into the state. Nursery and orchard inspection has been carried on as usual.

In addition to the inspection and control work which is described in the following pages, this department has coöperated with the botanical department in conducting a series of experiments in the spraying of apple and peach orchards in summer to control their various insect and fungous enemies. About 350 apple trees in seven different orchards, with 75 others reserved as checks, and 125 peach trees in three different orchards, with half as many checks, were under experimentation. An account of this work in detail, with the results obtained, has been published as Part VII of this report.

A number of commercial insecticides, mostly lime and sulphur preparations for destroying San José scale, have been tested in a small way, and similar tests have been made with some of these mixtures in destroying the eggs of plant lice on apple trees.

The entomologist is now preparing a check list of the insects which have actually been collected in Connecticut.. This will be published by the Geological and Natural History Survey of the state. Mr. Walden's paper on the Orthoptera of the state, finished some time ago, is now in press and will soon be issued as Bulletin 16 of the Survey. The paper on the Hymenoptera, prepared some time ago by Mr. Viereck, must await the action of the General Assembly before it can be published, as the funds for publishing will be exhausted before it can be reached.

The brown-tail moth has made its appearance in this state at Thompson and Putnam, and some scouting and spraying has been done because of it.

Brief studies have been made on two kinds of moths, the caterpillars of which we found on imported nursery stock from Japan; a Phorid fly infesting onion seeds in the germinator; a lepidopterous larva feeding on barberry; also observations on the 15-spotted lady beetle, birch bucculatrix, elm leaf beetle, San José scale, canker worms, and the various injurious and beneficial species that are sent for identification and that we run across in our field work.

Where such studies are in any sense complete, or where new facts have been brought out, the matter has been given more extended notice in the following pages.

Summary of Inspection and Office Work.

326 samples of insects received for identification.
47 orchards and gardens examined for insects.
47 nurseries inspected.
44 certificates granted. One certificate revoked.
707 boxes, bales and packages imported nursery stock examined.
208 apiaries containing 1,595 colonies inspected.
158 apiaries containing 793 diseased colonies found infested with European foul brood disease.
44 second inspections made.
1,881 letters written on official work.
61 packages sent out.
17 addresses made before granges, farmers' institutes and village improvement associations.

Exhibits.

As part of the general exhibit of the station this department exhibited insects and their work at five agricultural fairs during the fall. Beginning September 6th and ending October 8th, going to a different place each week, exhibits were made at Norwich, Willimantic, Rockville, Berlin and Danbury. Though much time was required to prepare these exhibits, they were seen by thousands of people, many of whom learned for the first time of the entomological work of the station.

The exhibit of the entomological department contained many pinned specimens illustrating the more important orders or groups of insects, including butterflies and moths, dragon flies, beetles, grasshoppers, crickets, flies, bees, bugs and scale-insects. There was also one case each devoted to gall insects, garden insects, fruit insects, forest insects and beneficial insects. Several

life history sets of well-known insect pests and common species were shown, as well as large charts of the former, and a number of insecticides and spray nozzles.

The gypsy moth, against which the state of Massachusetts has expended nearly $2,000,000, and which is present in Connecticut at Wallingford and Stonington, was the subject of a part of the exhibit, and was accompanied by figures showing the results of the work in Connecticut.

A feature of the exhibit which usually attracts attention was the living caterpillars and mosquito larvæ or wrigglers, and many paused to look at the latter and expressed their surprise to learn that they turn into mosquitoes—but the proof was before them. The exhibit of insects was also supplemented by over one hundred photographs of insects and their work, and by some of the publications of the state entomologist.

New Quarters.

The entomological department moved June 20th, 1910, into its new quarters on the second floor of the new brick addition, for the building and equipment of which the last General Assembly made an appropriation of $30,000. Much better facilities for work are now afforded than ever before. Including insectary, dark-room and storage closet, 1,500 square feet of floor space are now occupied by the department, apportioned as follows: Office and library, 14½ x 21½ ft.; collection room, 21½ x 27 ft.; laboratory, 19 x 22½ ft.; insectary, 6 x 16 ft.; and dark-room, 7½ x 8 ft. (both opening out of laboratory); storage closet, 4 x 7 ft. The office, collection room, laboratory and storage closet all open from the hall. The collection room is connected with both office and laboratory, and the latter is provided with closets, drawers, microscope tables, hood and sink. The collection room has three west and two north windows, and the laboratory has three north and two east windows, so that an abundance of north light is available. The rooms are heated by steam and lighted by both gas and electricity, and gas and electric outlets are conveniently arranged for all kinds of laboratory work. In the basement a room 21 x 26½ ft. is used jointly by the entomological and botanical departments for a display of insecticides, fungicides, pumps and spraying apparatus.

Entomological Features of 1910.

The season of 1910 brought a comparative scarcity of plant lice, and especially of the rosy apple aphis, which was so abundant and caused such damage to apple trees in Connecticut in 1909. In some orchards it was necessary to search a long time in order to find a single colony, and in no case did it cause injury. The 15-spotted lady heetle, *Anatis 15-punctata* Oliv., was extremely abundant, more so than I have ever seen it before, and from fifteen to twenty egg-clusters, containing altogether several hundred eggs, could be found on nearly every tree.

The green apple aphis, *Aphis pomi* DeG., was present in moderate numbers, as in 1909.

Canker worms, chiefly the fall species, *Alsophila pometaria* Harr., were abundant, and their devastation was widespread throughout the state on many different kinds of trees. It was especially noticeable, however, on apple trees, and many orchards were brown in early summer, as if scorched by fire. Mr. Champlain observed a large ground beetle, *Calosoma willcoxi* Lec., which was very abundant during the season, feeding upon canker worms, and some of the helpers on the station grounds saw a grey squirrel devour about forty canker worms on the trunk of an oak tree below the Tanglefoot band.

The elm leaf beetle, *Galerucella luteola* Müll., did a great deal of damage in certain parts of the State, especially in Thompson and in Glastonbury, according to reports received from correspondents. In some other places, however, like New Haven and Milford, where a careful and systematic spraying of the trees was practiced in 1909, the beetles were rather scarce, and some observers apparently thought that the pest was on the wane and would give us no further trouble. These towns and cities, however, sprayed their trees again in 1910, and the trees, especially in New Haven, presented a better appearance toward the end of the summer than for many years. The spraying should be continued.

Cut worms were especially troublesome, and mucb damage to tobaeco fields and gardens in June was reported to this office.

June beetles were very abundant early in the season, as might be expected from tbe damage to grass lands in 1909 from white grubs. June beetles defoliated trees in the vicinity of New London.

Rose beetles were also present in rather more than their usual numbers, and caused the ordinary amount of damage in gardens and vineyards.

Sawfly larvæ of several uncommon kinds were observed feeding upon plants not usually attacked, and an attempt was made to rear the adults of several species. The peach sawfly, *Pamphilius persicum* MacG., defoliated many trees in some of the large peach orchards, and though I have not heard of any attempt to check its ravages by spraying, some of the orchardists are now planning to spray their trees in 1911 with lead arsenate to prevent a repetition of the injury.

Sphinx larvæ were scarce in 1910, and nearly all of those observed were strongly parasitized. This was particularly true of the common tobacco or tomato worm, as every caterpillar which we collected showed before pupation the cocoons of *Apanteles congregatus* Say.

The brown-tail moth, *Euproctis chrysorrhœa* Linn., made its appearance in the state at Thompson in April, and was later found at Putnam. For several years this pest has been known to be near the borders of our state in Massachusetts and Rhode Island, but until this season it has not been found in Connecticut except on nursery stock imported from France. On other pages of this report are given accounts of this insect, and its occurrence in Windham County and on imported nursery stock.

During the latter part of August and during September the birch trees known as the white, grey, or bobbin birch, were stripped of their leaves throughout the northern and eastern portions of the State. The insect causing this defoliation was the birch bucculatrix, *Bucculatrix canadensisella* Chamb., a pest of northern New England and found in certain seasons in Massachusetts and Rhode Island; but it has not during my residence of over sixteen years in Connecticut shown any such outbreak. A fuller account of this insect is included in this report.

The increasing damage to shade trees by the leopard moth, *Zeuzera pyrina* Linn., which is boring in the branches of various kinds of trees in the cities, should be mentioned here; also that of the woolly maple leaf scale, *Phenacoccus acericola* King, which in Connecticut confines its attacks chiefly to sugar maples. The sugar maple borer, *Plagionotus speciosus* Say, is still a seri-

ous pest of sugar maple shade trees in towns and cities. Over sixty adult beetles were taken from the trunks of the street trees of Wallingford last summer by the gypsy moth men during their work of turning bands.

The San José scale has apparently diminished somewhat in its virulence or powers of spread and injury. Several instances have come to my notice where old apple trees which were infested several years ago, and which I thought would be dead before this, have taken on a new lease of life, and on examining them I find very few living scales. There seems to be no particular natural enemy that is responsible for the welcome check in the spread of this hitherto serious and destructive orchard pest.

Cabbage loopers, *Autographa brassicæ* Riley, have been common during the season, and in some fields apparently did even more damage than the cabbage worm. The remedy, however, is the same.

Two kinds of insects, both lepidopterous larvæ, have been brought into this country on nursery stock from Japan. One, feeding upon a deciduous shrub resembling lilac, was reared, and the adult finally identified as *Hemiscopis cinerea* Warren, which is mentioned elsewhere in this report. The other was feeding upon a conifer, *Abies tomomi,* and was found in shipments sent to two Connecticut nurseries. The adult stage, however, was not obtained.

Inspection of Connecticut Nurseries.

The inspection of growing nursery stock was commenced September 1st, and completed about November 1st. It was done by Messrs. Walden, Caffrey, Champlain and Britton.

On the whole the nurseries were in better condition as regards the scale than for several years. This is probably due to the increased care and attention given the growing nursery stock by some nurserymen and to the diminished power of multiplication of the San José scale.

The list of nurserymen changes slightly from year to year. This year's list contains forty-two names as against forty-seven last year and forty in 1908. Of these, six have been dropped, though three of them may receive certificates when they have carried out the directions of the state entomologist in regard to the treatment of infested stock. One has been added since last

year, and another nursery has changed hands. Altogether forty-eight nursery inspections were made during the year, forty-four certificates were granted, and one of these was revoked on account of the nurseryman moving his business elsewhere.

The list follows:

LIST OF NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1910.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Atwater, C. W.	Collinsville	Oct. 7,	383
Barnes Bros. Nursery Co.	Yalesville	Oct. 13,	386
Beattie, Wm. H.	New Haven	Nov. 12,	412
Bowditch, J. H.	Pomfret Center	Sept. 24,	376
Brainard, D. Wm. & C. F.	Thompsonville	Nov. 12,	409
Braley & Co., S. A.	Burnside	Oct. 4,	382
Brooks Bros.	Westbrook	Oct. 1,	379
Burroughs, Thos. E.	Deep River	Sept. 30,	378
Burr & Co., C. R.	Manchester, Buckland, Durham,	Sept. 20,	374
Chapman, C. E.	North Stonington	Oct. 27,	399
Comstock & Lyon	Norwalk	Oct. 24,	396
Conine Nursery Co., The F. E.	Stratford	Oct. 8,	384
Conn. Agricultural College	Storrs	Nov. 5,	408
Conn. Agr. Experiment Station, Forest Nursery (S. N. Spring, State Forester, New Haven)	New Haven and Rainbow	Nov. 12,	411
Conway, W. B.	New Haven	Oct. 24,	398
Cross Highway Nurseries	Westport (2)	Oct. 22,	394
Dehn & Bertolf	Greenwich	Oct. 14,	387
Dwyer, John E.	Manchester	Sept. 15,	373
East Rock Park Nursery (G. X. Amrhyn, Supt.)	New Haven	Sept. 20,	375
Elm City Nursery Co.	New Haven	Sept. 27,	377
Fernwood Nursery	Stamford	Oct. 20,	390
Hale, J. H.	So. Glastonbury	Nov 2,	405
Houston & Sons, J. R.	Mansfield Depot	Nov. 3,	407
Hoyt's Sons Co., Stephen	New Canaan	Oct. 3,	380
Hubbard & Co., Paul M.	Bristol	Oct. 28,	401
Hunt & Co., W. W.	Hartford	Oct. 21,	392
Kelsey & Sons, David S.	West Hartford	Dec. 22,	415
Keney Park Nursery (G. A. Parker, Supt.)	Hartford	Dec. 8,	413
Mount Carmel Forest and Nursery Co.	Mt. Carmel	Nov. 2,	406
North-Eastern Forestry Co.	Cheshire and East Haven	Oct. 27,	400
New Haven Nursery Co.	New Haven	Oct. 18,	388
Phelps, J. Wesson	Bolton	Nov. 2,	404

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Pierson, A. N.	Cromwell	Oct. 13,	385
Platt Co., The Frank S.	New Haven	Oct. 28,	402
Purinton, C. O.	Hartford	Dec. 12,	414
Rosemore Nursery Co.	Litchfield	Oct. 24,	395
Schleichert, F. C.	Bridgeport	Oct. 20,	391
Schoonman, W. J.	Danielson	Oct. 24,	397
Scott, J. W.	Hartford	Oct. 22,	393
Sierman, C. H.	Hartford	Nov. 12,	410
Vidbourne & Co., J.	Hartford	Oct. 19,	389
Woodruff, C. V.	Orange	Oct. 29,	403

INSPECTION OF IMPORTED NURSERY STOCK.

By W. E. Britton and B. H. Walden.

On account of our experience the previous year (see Report of this Station for 1909-10, page 328) in finding nests of the brown-tail moth on nursery stock imported from France, and in the continued absence of any system of Federal inspection of such stock, in order to protect the state from wholesale and rapid infestation with this most undesirable pest, an attempt was made to inspect all woody nursery stock brought into Connecticut during 1910. We were notified of many shipments by Dr. L. O. Howard of the Bureau of Entomology at Washington, and of others by Mr. George G. Atwood, who has charge of the nursery inspection work in the State of New York. Thanks are due to both these men for many courtesies extended to us in this matter. There were some shipments, however, which we could not trace, and some arrived unheralded and were duly inspected. The total amount of nursery stock imported into Connecticut in 1910 was more than twice that of 1909, according to our records of the stock examined.

On January 31st, 1910, the following letter was sent to every Connecticut nurseryman:

New Haven, Conn., Jan. 31, 1910.

Dear Sir:—Last winter thousands of nests of the Brown-tail Moth, *Euproctis chrysorrhœa* Linn., were brought into the United States on nursery stock from France, and in the absence of any system of Federal inspection, this infested stock was shipped into nearly all of the Eastern States. Fifty-two of these nests were found on stock shipped into Connecticut, out of 224 boxes and packages examined. Again this winter

these nests have been found on rose stock from France brought into New York State, and if such stock is not inspected, the Eastern nurseries will soon become infested and the business seriously injured.

I therefore request you to notify me at once of any importations received during the fall or winter not already inspected, or of any shipments expected this spring, so that an inspection can be made. Please hold all boxes and packages without unpacking until an inspector can reach your nursery. We will examine the stock as promptly as possible after receiving notice that the goods have arrived at your nursery.

Very truly yours,

W. E. BRITTON,
State Entomologist.

In reply to this letter the nurserymen as a rule promptly notified this office of the arrival of stock, and some of them put themselves to much inconvenience and furnished labor at considerable expense to aid the inspection work. There were a number of small packages consigned to private places which were planted out or distributed among friends, and could not be examined. The inspection work was done by Messrs. Walden, Champlain and Britton, and of course a large proportion of this stock arrived in March and April. In all 707 boxes, bales and packages were examined, coming from nine different countries. Fewer brown-tail nests were found than last year, but fourteen of these were found in five cases of pear, apple and rose stocks brought into three Connecticut nurseries in widely separated localities. The nests came from three different French nurseries—André Leroy, Angers, two nests on pear; Franco-American Seedling Company, Angers, nine nests on apple; and E. T. Dickinson, Chateny, three nests on *Rosa multiflora.*

All stock from the infested boxes was dipped, root and branch, in Scalecide (1–20), and all the packing material was treated in the same way or else burned to destroy any caterpillars which might have crawled from the nests.

In addition to the brown-tail nests, two shipments of ornamental stock from Japan contained living caterpillars, one of *Hemiscopis cinerea* Warren (described elsewhere in this report) on a deciduous shrub resembling lilac, and an undetermined larva feeding on *Abies tomomi* and appearing to be capable of doing considerable damage.

The inspection of this imported stock required an amount of time equivalent to one man's work for more than two months.

One man could not have examined it all, however, without great delay and in some cases serious injury to some of the stock. In the rush of the season the services of three men were required on some days, all in different nurseries.

SOURCES OF IMPORTED NURSERY STOCK.

Holland	376
France	104*
Belgium	91
England	63
Japan	26
Scotland	19
Ireland	18
Germany	9
Russia	1
Total	707

INSPECTION OF APIARIES.

The last General Assembly made provision for the inspection of Connecticut apiaries on account of the diseases known as "foul brood," and the inspection work was placed in charge of the state entomologist. The law took effect at the beginning of the fiscal year, October 1st, 1909, but it was too late to make any inspection of apiaries until the following spring. Following the provisions of the act, however, inspectors were appointed as follows: Mr. A. W. Yates of Hartford for the northern half of the state, including Litchfield, Hartford, Tolland and Windham counties: Mr. H. W. Coley of Westport for the southern half, including Fairfield, New Haven, Middlesex and New London counties.

The full text of the act is as follows:

AN ACT CONCERNING THE SUPPRESSION OF CONTAGIOUS DISEASES AMONG BEES.

Chapter 185 Public Acts of 1909.

SECTION 1. *Duty of state entomologist to act on complaint.* For the purpose of suppressing contagious or infectious diseases of the honey bee, it shall be the duty of the state entomologist, when complaint is duly made, to examine and verify, and treat or destroy cases of foul brood among honey bees.

* Five cases of stock from three French nurseries, shipped to three Connecticut firms, were infested with fourteen nests of the brown-tail moth.

SEC. 2. *Authority to appoint inspectors and to examine apiaries.* In pursuance of the provisions of this act, the state entomologist or any person whom he may appoint for that purpose shall have access at reasonable times to such apiaries or places where bees are kept and where honey-comb and appliances are stored as may be designated in any such complaint.

SEC. 3. *Authority to make regulations.* The state entomologist is authorized and empowered to prescribe suitable forms for and make regulations regarding such complaints, and shall keep the same on file and open to public inspection; and he is further authorized and empowered to make, in his discretion, reasonable rules to govern, and reasonable payments for the services of agents whom he may appoint to carry out the provisions of this act.

SEC. 4. *Obstruction illegal. Penalty.* Any person who impedes, resists or hinders the state entomologist or any agent whom he may appoint in the performance of the duties imposed by this act shall be fined not more than twenty-five dollars.

SEC. 5. *Provision for defraying expenses.* To carry out the provisions of this act the necessary expenses, to an amount not exceeding five hundred dollars, shall be paid by the comptroller on duly accredited vouchers.

Approved August 2, 1909.

Though inspections can be made only on complaint a man can sign a complaint against his own apiary, and this was done in perhaps a majority of cases. The complaints were sufficient to exhaust the appropriation during the first season. The inspections began the last week of April and were finished by the end of August. In all 208 apiaries, containing 1,595 colonies or hives of bees, were inspected. Of this number 158 apiaries and 793 colonies were found infested with European foul brood, *Bacillus alvei*. In all cases the inspector either treated the diseased colonies or instructed the owner how to treat them. If in the last stages, the colonies were usually destroyed by fire, but if only slightly diseased, the bees were shaken out on to new frames and foundation and placed in a clean hive, and the old hives and sometimes the frames were disinfected by scorching. The second inspections showed great improvement, and in most cases entire freedom from the disease.

The European foul brood was thus found in twenty-five towns of the state. In seven towns where inspections were made no diseased colonies were found, but in these cases only one or two, or at most but a few apiaries were inspected. So it is not fair to assume that the foul brood does not exist in these towns, as further work is almost certain to reveal it. So far, most of

the inspecting work has been done in Fairfield, Hartford and Windham counties. Very few inspections have been made in Middlesex, New London and New Haven counties, and none in Litchfield and Tolland counties. It is probable, however, that considerable foul brood will be found in nearly all parts of the state as soon as anyone looks for it. Other portions of the state will be examined as soon as additional funds are available for the work.

A card catalogue in duplicate, one arranged alphabetically and one by towns, is on file in this office. It is desirable to have this catalogue as complete as possible, and it should contain the name and address of every beekeeper in the state. All records available, such as number of colonies, date and result of inspections, etc., are placed on these cards for future reference. We therefore request all readers to coöperate by sending in names of beekeepers known to them, especially those who are not members of the Connecticut Beekeeper's Association.

SUMMARY OF APIARY INSPECTION.

	Apiaries	Colonies
Number, first inspection	208	1,595
Infested with European Foul Brood	158	793
Number, second inspections	44	

Number of towns containing diseased bees	25
" " where disease was not found	7

Money expended	$499.85
Average cost per apiary	2.40

Other troubles reported by the inspectors:

Paralysis	2 cases
Spring Dwindle	2 "
Wax Moth	1 case
Poisoned from sprayed trees	3 cases

CONTROLLING THE GYPSY MOTH IN CONNECTICUT.

WALLINGFORD INFESTATION.

The discovery of the gypsy moth at Wallingford in December, 1909, was recorded in my last report. (See Report of this Station for 1909-10, page 337.) Immediate steps were taken to eradicate the scourge and at first helpers from the station were

sent to creosote the egg-masses which were in plain sight in order to destroy them before the eggs were scattered. On January 24th Mr. Donald J. Caffrey took charge of the field work as superintendent, and resided in Wallingford through the spring and summer. He was given authority to hire and discharge whomever he saw fit, under certain regulations. At first he employed but few men, and worked with them, teaching them how to do the different parts of the work. As opportunity offered, other men were taken on, and the best ones retained. There was pruning and scraping, carting and burning of brush, filling and tinning of cavities, in connection with the trees and fences, rubbish and outbuildings to overhaul during the winter, besides a careful examination of the entire village and the surrounding country to ascertain the limits of the infested area. Mr. Caffrey did much of the scouting himself, besides looking after the men, and the results of the work are largely due to his faithfulness and thoroughness.

It may be stated here that no infestation has been found outside of the village of Wallingford, though much hunting has been done by state and Federal scouts, and the map on page 339 of the last report still shows very accurately the location of the infestation. The only change to be made is in extending the area in its southern portion eastward across Fair Street to Elm Street. According to computations made by Mr. R. W. Bolton, the area in Wallingford actually infested with the gypsy moth equals only 0.378 of a square mile. In the summer the trees throughout the infested section and in a surrounding zone were banded with burlap to trap any stray caterpillars or to catch those hatching from any egg-cluster which might have been overlooked. Some of these bands were turned each day during the caterpillar season, and all were examined frequently, and all caterpillars found were destroyed. Nearly all of the trees known to be infested were sprayed with arsenate of lead to kill the caterpillars feeding upon the foliage, in the hope of making sure of some in this way that might escape the bands.

Tree Tanglefoot bands were applied to many trees for the purpose of preventing the caterpillars from going up or down the trunk or branch of the tree. This material is effective in many cases where it is impossible or impracticable to catch the caterpillars under burlap or by spraying with poison. There

are sometimes egg-masses in cavities of trees or holes in fences which cannot be reached or covered, and by placing a band of Tanglefoot entirely around the spot, the young caterpillars are caught in it on leaving the nest for their food. Thousands of young caterpillars were killed in this way.

At the end of the caterpillar season in August, the bands were removed from the trees and all work suspended until November 1st, when the leaves were off the trees and scouting for egg-masses could be done to advantage.

I wish to express here my hearty appreciation of the spirit of coöperation which was manifested by the town and borough officers, who supplied help in the first days of the work; furnished storage room for tools and supplies; loaned us ladders, and caused several back yards to be cleared of rubbish. The residents and property owners generally have shown interest in the matter and have coöperated with us. Nearly all seemed anxious to help clean up the infested territory, and this work was greatly furthered by the efforts of the Village Improvement Association, which culminated in a "clean-up day" on March 25th, when much rubbish was carted to the Whittlesey Avenue dump and burned under the direction of our men. The only hindrance encountered was from an insane man on Franklin Street, who drove the men off his grounds and tore the bands from his trees, but he was removed to a retreat early in the season, and after that his trees were properly treated.

Scouting for Egg-masses.

As the egg-clusters were very abundant in the worst infested centers, nearly 6,000 were found and destroyed by the station helpers during the first two weeks of the work at Wallingford. Then a heavy snow prevented effective work for a month. This first work had been hurried, as it was important that all exposed egg-clusters be treated at once so that if they were broken and the eggs scattered, as was sure to happen with some of them, the eggs would not hatch. Birds undoubtedly break open some of the clusters, and those on the trunks of trees are often scattered by boys scraping them off or by horses rubbing against them. Many of those first found in Wallingford had been broken and the eggs scattered in this manner. When Mr. Caffrey and his men began, therefore, most of the prominent egg-masses had been

found and creosoted, but it was necessary to hunt for them in cavities of trees, under fence rails, under verandas, in tin cans, and in various out-of-the-way places. This work was done very thoroughly, and kept up until May 1st, when it was time for the eggs to hatch. Three or four large shellbark hickories south of Center Street near Whittlesey Avenue were found to be infested with egg-masses, most of them being on the under sides of the loose pieces of bark or "shingles," and discovered only after these were removed from the tree. Two such trees had about 400 egg-clusters on each.

One apple tree on Prince Street contained ninety-seven egg-masses and thirty-seven were found between the old boards of a patched fence on Williams Street. Some of the egg-masses were in singular places. One was found on the shade or cover of an incandescent electric street light, and a hollow branch of a pear tree (shown on Plate XXIII, a) having a crack on one side contained forty-nine egg-masses, one of which was deposited upon the side of a small hornet's nest in the hollow.

In all 8,234 egg-masses were found and destroyed. Mr. Caffrey was continually scouting, not only during the destruction of the egg-masses but throughout the caterpillar season.

In addition to the scouting done by the state men, three Federal scouts were placed in Wallingford February 9th, and later the number was increased to five. These scouts covered the territory under authority from this office granted by the legislature in Section 2, Chapter 114, of the Public Acts of 1907, page 666, which reads as follows:

> "The state entomologist shall have authority to suppress and exterminate said gypsy and brown-tail moths, and may employ such assistants and laborers as he deems expedient; may cut and burn brush and worthless trees in fields, pastures, or woodlands, or along the roadsides on any public or private grounds; and may prune, spray, scrape, or fill cavities in any fruit, shade or forest trees, or clean up any rubbish for the purpose of furthering said work. The said state entomologist, or any of his assistants, deputies, agents, or employees, shall have the right, at all times, to enter any public or private grounds in the performance of their duties."

The Federal scouts examined the entire region around the village where our men had not gone over the ground. They spent the entire season scouting, and covered the whole town of Wallingford except in the center of wooded areas; Meriden, both city and town; Berlin; New Britain; New Haven; parts

of Orange, including West Haven; East Haven, Branford and North Haven; and are at the time of this writing scouting around the city of Hartford and the town of Newington, and expect to cover the territory northward on both sides of the river to the Massachusetts line. In all this scouting work no gypsy moth infestation was found outside of the village of Wallingford. Another force of Federal scouts covered a portion of the northeast corner of the state, including the towns of Thompson, Putnam, Pomfret and Woodstock. In all probability the pest will soon spread into this part of the state from the nearby infested territory of Massachusetts and Rhode Island, as is the case with the brown-tail moth, as described on page 683 of this report.

Commencing November 1st, Mr. Caffrey and three men examined the entire infested area in Wallingford, but though a careful search was made, only twenty-three egg-masses could be found.

Pruning and Scraping Trees.

Many vacant lots in Wallingford contain apple trees, some of them being the remnants of old orchards on the land before it was cut up into building lots. Such trees have not been cared for, and at the beginnning of the gypsy moth suppression work were crowded with living and dead branches, cavities and water sprouts. Nearly every back yard also contained one or more fruit trees, and though many of these were in good condition, some had been neglected like those on the vacant lots, and all needed more or less attention. These trees were first pruned, all dead branches were removed, then such living ones as might be necessary to the best growth of the tree and enough to let light and air into its top. All wounds were painted over with dark green or brown paint. A few property owners burned their own brush, but hundreds of loads thus removed had to be disposed of, and most of it was carted to the dump on Whittlesey Avenue and burned after drying slightly. Then all rough loose bark was scraped from the trunks and larger branches, care being taken not to injure the cambium, but leaving no upturned edges of bark under which caterpillars could hide.

Most of the trees thus treated were on private property, and where the owners were not likely to take any action, and in most cases did not know what to do. Few street trees

were pruned in this way by men on the force, but some of the street trees were pruned by men employed by the warden of the borough, Mr. William E. Becroft. Altogether over 900 trees were pruned by men employed by the state in order to make it possible to do effective work in controlling and suppressing the gypsy moth in Wallingford.

Hedge around Cemetery.

The Norway spruce hedge around the cemetery was infested with egg-masses along the Center Street side. The egg-clusters were not only on the trunks and branches, but also on the small twigs, and even on dead leaves in the tops of the trees. The growth of these trees was extremely thick in the tops, which had been sheared each year, and it was impossible to treat the egg-masses without destroying this portion of the hedge.

Many of the trees had died, rendering the hedge unsightly, and as it was close to the street and trolley line and high enough to obscure the view of approaching teams, automobiles and trolley cars at the corner, and as several accidents had occurred, some of the citizens asked us to remove the hedge. A conference was held with the town and borough officials, and it was finally decided to remove the hedge along the Center Street side of the cemetery and for a few feet back on Orchard and Colony streets, so as not to obstruct the view at these corners. On April 18th the hedge was removed for a distance of 875 feet, containing 148 trees. The trees were sawed off close to the ground, lifted upon a wagon and carried to the dump, where they were trimmed. All egg-masses found on the trunks and branches were creosoted and all of the small brush burned.

The hedge on the other three sides of the cemetery (over 2,000 feet and containing 340 trees) had lost its lower branches, making it unsightly. These were cut off, carted away and burned, together with all dead leaves and other rubbish under the hedge. Several loads of tin cans also had to be removed.

It has since been decided by the local authorities to widen the street against the cemetery and to build a wall in place of the hedge.

Covering and Filling Cavities.

Many of the trees that were pruned also needed attention in other directions. Deep or shallow cavities, hollow trunks or

branches and broken and torn limbs all provided hiding places for caterpillars and had to be eliminated before thorough and effective work could be done. Wherever possible all cavities were covered with patches of tin, closely fitted and nailed to the wood and painted dark green or brown, to make them inconspicuous. This is much less expensive than to fill the cavities with cement concrete, but in some cases where the margins were ragged and uneven, or where it was desired to prevent the exit of any caterpillars hatching from undiscovered egg-masses which might possibly be in the cavity, the latter treatment was used. One part of the best Portland cement was mixed with three parts sand and five parts crushed stone, and in large cavities brick or larger stone was used to help fill the opening. Several large and irregular cavities in the street trees on Center Street were filled in this way. These trees were in such shape as to make moth extermination impossible without treatment, and a thorough job was done, partly as an object lesson. Some of the tin patches have been injured by thoughtless or careless persons puncturing holes in them, so that they must be renewed, thus increasing the cost of the work.

In all twenty-seven large cavities were filled with cement and 1,959 were covered with tin patches.

Fences and Walls.

Mention has already been made of an old fence between Williams and Meadow streets which had been patched up with boards from time to time until it scarcely resembled a fence. As this was in the worst infested center in the town, and many egg-masses were found and creosoted on the outside of it, it was necessary to overhaul it in order to destroy the eggs which were almost sure to be found between the boards. This was done on April 15th, and thirty-seven egg-masses were found. The old fence was taken away entirely and a new fence of wire netting built in its place.

On Franklin Street a retaining wall had been built of old railroad ties at the rear of a residence, and close beside it stood one of the large hickory trees which have already been mentioned as being badly infested. This wall made an excellent place for caterpillars to crawl in where they might transform and the eggs be laid entirely out of our reach. We had planned, therefore, to

cover the face of the bank with wire netting and plaster it up with cement mortar to keep out the caterpillars. The owner, hearing of this, wished to build a permanent wall, and asked us to help toward it instead of making temporary repairs which would be of no benefit to him. A sum equal to the cost of the wire and plaster work was therefore paid, and a tight permanent stone wall was built. Some plaster work and pointing up was done on the next lot, making the bank wall safe against further infestation.

Banding Trees with Burlap.

All trees throughout the infested area and in a wide zone around it were banded with burlap during the month of May. This means that all fruit, shade and ornamental trees growing within the area covered by the map shown on page 339 of the report for 1909, and some further southwest and east, were banded. In all, this amounts to about 10,000 trees, and 2,493 yards of burlap were required. The eight-ounce grade was used, and it was purchased cut in eight-inch strips ready to apply. It was fastened to the trees with jute twine, about 102 pounds being used.

Banding Trees with Tanglefoot.

In the most densely infested portion of the area, bands of a sticky substance known as "Tree Tanglefoot" were placed around the trunks to prevent the crawling up of caterpillars, many of which might be expected to hatch from the eggs scattered upon the ground. The Tanglefoot was smeared upon the bark at a convenient height, and served to catch thousands of small caterpillars. This material remained sticky for several weeks, but had to be combed over occasionally to prevent it from becoming hard enough for insects to cross. Tanglefoot was also used on many fence posts, and was placed on a large sheet of paper around the hollow pear limb shown on Plate XXIII, a, and all the caterpillars were caught in it as soon as they hatched and tried to crawl away. Many of these bands had to be renewed. In all 365 trees were thus treated, requiring 120 lbs. of Tree Tanglefoot.

Spraying with Poison.

Most of the trees in the worst infested section were sp
with arsenate of lead, 5 lbs. in 50 gallons of water. The

sprayed were mostly in yards and in the cemetery, though street trees were sprayed on Williams, Orchard, Union and Franklin streets, Whittlesey Avenue and between Main and Elm streets. In fact, they were sprayed in all of the badly infested spots.

The remaining portion of the hedge, nearly half a mile in length, was thoroughly sprayed twice. Hundreds of shrubs, rose bushes, and vines were also sprayed. Most of the spraying work was done by J. Taylor, who was employed with a team for half of each working day. Some hand work was done by the other men, however, as the small wheel outfit enabled them to go into back yards for small jobs without a team. From the dead caterpillars observed on the leaves of small trees in back yards, we know that the poison killed hundreds and probably thousands of them.

Some of the elm trees of the borough were sprayed by the Village Improvement Association, and by property owners to prevent the ravages of the elm leaf beetle. Though this work was not directed against the gypsy moth, it all helped toward controlling that pest.

Over 200 street and back yard trees, exclusive of those in the cemetery hedge and the shrubs and vines, were sprayed by our men, and 768 lbs. of lead arsenate was used.

Destroying Caterpillars.

The men employed to turn bands were supplied with small forceps and small stoppered jars or bottles containing denatured alcohol or gasolene. All caterpillars found were dropped into the liquid and brought to the tool house, each man reporting each day and showing his catch.

The first egg-mass to hatch was one inside the tool house, which commenced hatching on March 30th. The first caterpillars were observed out of doors on April 18th, but they were not found under the burlap bands until May 27th, when they were about an inch long. The most taken in one day was 1,312 on June 14th. The last one was gathered on August 5th, and in all 8,936 caterpillars were destroyed at burlap bands and on the trunks of the trees, exclusive of those killed by spraying and by the Tanglefoot. Some of the caterpillars pupated, and ninety-five cocoons were found and destroyed.

Food Plants of the Caterpillars at Wallingford.

Gypsy caterpillars are known to feed upon nearly six hundred different kinds of plants, yet they have a choice, and when they are able to exercise it they have a much shorter *menu*. At Wallingford they were observed by Mr. Caffrey to feed upon the following trees and plants: Apple, pear, plum, cherry, quince, rose, wild cherry, maple, hickory, chestnut, elm, sycamore, willow, poplar, spruce, larch, grape, wistaria and lettuce.

Natural Enemies.

No natural enemies of the gypsy moth were noticed at Wallingford except in one case, when some caterpillars were gathered and one had twenty-five white Tachinid eggs on its back. This was placed in a separate jar, and after feeding, in due time pupated, but the adult moth never emerged. On September 1st a large two-winged fly appeared in the jar, and this was identified by Mr. C. W. Johnson as *Tachina mella* Walk., a species previously recorded as being parasitic upon the gypsy moth in Massachusetts. The gypsy moth cocoon was closely packed with Tachinid puparia, but no other flies emerged and evidently they could not get out.

Observations.

While working in a tree, one of the men, Mr. R. W. Bolton, observed a gypsy caterpillar crawling along a telephone cable which passed through between the branches of the tree. This method of spreading may account for the caterpillars appearing in certain trees where all egg-masses had been destroyed and a Tanglefoot band placed around the trunk. Telephone wires passed directly from infested trees into these described.

Mr. Caffrey found an unusually large egg-mass on August 22d, which had apparently been laid at one time by one female, and on counting, it was found to contain 1,485 eggs.

The first hatching of eggs was in the tool house on March 30th. Outside the first caterpillars were observed on April 18th and first taken under bands on May 27th. The first pupa was found on June 23d, and the first adult female July 7th.

Tool Houses.

As quarters were needed for storing tools, pumps and supplies, and as a place for the men to report each morning, Mr. Becroft,

warden of the borough, kindly placed at our disposal a basement room under the town hall, which was used throughout the season. This point was central and near the trolley lines. For the storage of poison, pumps, etc., space was allotted us in a large storehouse used by the borough near the steam railroad.

Force Employed.

Except for the first two weeks before Mr. Caffrey took charge, local men were employed. For the scouting and pruning not many men were needed, but in the summer, when there was pruning, cavity work, spraying, turning bands and applying burlap and tanglefoot, more help was necessary, and as many as eighteen men were employed, while the least number working at any time was five.

Cost of the Work.

Up to the end of the calendar year of 1910 the total amount of money expended by the state for the suppression and control of the gypsy moth at Wallingford was $3,823.34. The last General Assembly appropriated the sum of $10,000 for this work for the biennial period ending September 30th, 1911.

A considerable sum has also been expended by the Federal authorities for scouting in this part of the state, but the exact figures are not at hand at the time of this writing.

The work at Wallingford is summarized below, but the figures do not include the thousands of young caterpillars killed by spraying and by the Tanglefoot bands, or the hundreds of trees in the spruce hedge of nearly half a mile in length around the cemetery, all of which were sprayed twice.

SUMMARY OF THE GYPSY MOTH WORK AT WALLINGFORD, 1910.

Egg-masses destroyed	8,234
Trees banded with burlap	10,000
Trees banded with Tanglefoot	365
Trees pruned	904
Cavities filled with cement	27
Cavities covered with tin patches	1,959
Trees sprayed with poison	219
Caterpillars destroyed at burlap bands	8,936
Cocoons destroyed	95
Number of trees found infested	248
Amount of lead arsenate used, lbs.	768

Amount of Tanglefoot used, lbs.	120
" " burlap used, yds.	2,493
Number of men employed—maximum—	18
" " " " —minimum—	5
Cost of state work at Wallingford	$3,823.24

Stonington Infestation.

The work here was in charge of Mr. Horace Niles Trumbull, a student of Union College, who has been employed on the work for two or three seasons under Mr. Hollister. As Mr. Trumbull could not commence work until about the second week in June, he arranged that the banding of the trees should be done by Mr. J. E. Fairbrother, who was familiar with the work on account of having assisted in it in 1909.

As only ninety-eight caterpillars were found in 1909, much the smallest number since the discovery of the infestation in 1906, and as the combined efforts of state and Government scouts revealed but a single egg-mass in December, 1909, it was expected that few, if any, caterpillars would appear in the summer of 1910. But evidently one egg-mass had been overlooked, for during the summer 146 caterpillars were found and destroyed by our men. It was considered necessary at the beginning of the season to band and spray trees, and in fact manage the whole matter exactly as if caterpillars were known to be present, so the banding was done in the usual manner. No caterpillars were found until June 17th, when Mr. Trumbull noticed one feeding on some foliage in the yard of Mr. Koelb of Elm Street. A careful search was made, and over sixty were found and destroyed that afternoon. The grass, raspberry bushes and other vegetation along the wall were cut and burned, and the wall burned out with oil. All other vegetation in the yard was sprayed with lead arsenate. Later a few caterpillars were found at the Stanton place and at Mr. Darrell's, and all the trees and shrubs in the vicinity of those infested on both places were sprayed. The bands were examined for several weeks after any caterpillars were found.

Mr. Trumbull did much scouting for caterpillars outside of the yards infested. As in 1909, no caterpillars were found at Walnut Grove, though all the trees there were banded and a sharp watch was kept for them. The first cocoon was found July 14th.

Brush and weeds were cut and burned in several places, but it was not necessary to do much pruning or cavity work, as this had all been done in previous years. All bands were removed and the work closed on August 20th.

Following is a summary of the season's work at Stonington:

SUMMARY OF THE GYPSY MOTH WORK AT STONINGTON.

Egg-masses destroyed	1
Trees banded with burlap (approx.)	6,500
Trees banded with Tanglefoot	105
Trees sprayed (mostly small) (approx.)	200
Number of trees found infested	20
" " places found infested	5
Caterpillars destroyed	146
Amount of lead arsenate used, lbs.	100
" " Tanglefoot used, lbs.	40
" " oil used, gallons	25
" " burlap used, yds.	1,226
Number of feet of stone wall burned out	900
" " men employed—maximum—	5
" " " " —minimum—	3
Cost of season's work at Stonington	$588.58

The total cost to the state of all suppression work against the gypsy and brown-tail moths and in inspecting imported nursery stock in Connecticut for the past year has been $4,542.27. In addition to this the Federal authorities have expended $4,817.74 in scouting different parts of the state.

THE BROWN-TAIL MOTH IN CONNECTICUT.

In two previous reports of this station (see Reports for 1902, page 165, and for 1907, page 313) as well as in Bulletin 153, page 8, information has been given regarding the brown-tail moth, *Euproctis chrysorrhœa* Linn., but at the time that these publications were issued that insect had not been found in Connecticut, all reports to the contrary notwithstanding. Several newspapers have reported its presence, but whenever the reports were investigated, the insect always proved to be some other species or else the report could not be traced to its source and the responsibility for it fixed. On April 6th, 1910, specimens of nests and dead caterpillars were received from Mr. Richard Barton of Thompson, with the following letter:

Dear Sir:—I am mailing to you under separate cover in a box some caterpillars' nests found near the highway on a pear tree by one of Mr. H. L. Frost's men, who was doing some pruning in this village. He thought it was the brown-tail, and so I took them and carefully cyanided them and sent them to you for identification. I really hope that they are not brown-tails, as we have not yet been troubled with them in this section. However, if you find that they are, if you will kindly let me know at once I will see what I can do to have a search made in the village with a view to stamping them out.

Yours very truly,

RICHARD BARTON.

The insect proved to be the brown-tail moth, and Mr. Barton was notified to that effect. The information came at a time when all the men were very busy, and imported nursery stock was arriving daily, and of course had to be inspected at once. Messrs. Walden and Champlain visited the place on May 4th and hunted for nests and for the work of the caterpillars. Mr. Walden made notes as follows:

"Looked up Mr. Barton, who is manager of the estate of Norman B. Ream. He stated that a Mr. Lynch, foreman for the H. L. Frost Company, found the nests on a pear tree on the place of E. S. Backus, which adjoins the Ream estate. Mr. Barton took us to the place and showed us the tree. The end of a branch for two or three feet showed insect work, and a web not unlike that of the tent caterpillar was seen on the branch, but on examining the caterpillars they were found to be those of the brown-tail moth. Nests were seen on a pear tree near the side of the barn and on two apple trees at the rear of the house. Upon examining trees in near-by yards, nests were found on trees in two yards on the other side of the street. They were found on one tree 400 to 500 feet from where first found. About 12 nests in all were seen.

"Apple, pear and cherry trees were examined on the road towards Rhode Island for about one-third of a mile, and no nests were found. We examined the trees on the road towards Massachusetts for about a mile. Apple trees were generally well covered with blossoms, and other trees were coming into leaf, so that it was rather difficult to find nests.

"On May 10th, went up to Thompson and sprayed the trees where brown-tail moth nests were found. Used 13 lbs. Swift's lead arsenate, 6½ lbs. to the barrel (about 50 gallons). Mr.

Barton furnished two men, pump and team to do the work. It was very windy, but the trees were sprayed as thoroughly as possible under the conditions."

About a month later, two nearly full-grown dead caterpillars were received from Professor George H. Lamson, Jr., of the Agricultural College at Storrs. These were handed to him by Mr. J. H. Osgood, who found them feeding upon fruit trees at Putnam. On June 15th Mr. Walden visited Putnam and met Mr. Osgood, who boarded at Mr. E. Williams', 157 Elm Street, where he found the caterpillars on trees in the yard. Mr. Osgood had previously sent some of the nests to a Willimantic paper. He showed Mr. Walden around the place where he had observed the insect and its work. A pear tree in the yard of Mrs. Thurber, at 143 Elm Street, was nearly defoliated, and is shown on Plate XXXI, b. Two pear trees in a yard on the corner of Buck Street and three or four blocks west of Elm Street, were found infested, and a pear tree near a blacksmith's shop just west of Elm Street showed the work of the caterpillars. On School Street, east of the railroad and some distance from Elm Street, the work of the insect was apparent in two yards. In two other yards on the same street pears and apples were found infested. Mr. Walden made an effort to learn the extent of the territory infested rather than to discover all of the infested trees within that area.

At this time most of the caterpillars had pupated; so that spraying was not attempted.

In November, Mr. D. M. Rogers, special field agent of the Bureau of Entomology, in charge of preventing the spread of the gypsy and brown-tail moths, wrote that his men, who had been scouting Thompson, Putnam and Pomfret, found brown-tail nests in Thompson and Putnam, and at the latter place the nests were rather abundant on fruit trees in the yards about the town.

These infestations in Thompson and Putnam are probably on the edge of the area generally infested, which has nearly reached Connecticut for two years in both Massachusetts and Rhode Island. Mr. Rogers reports that his scouts have also found the pest at Wilbraham, Mass., which is just east of Springfield, and of course the infestation may extend all the way to Putnam. During the winter much scouting will be done in this locality,

and all nests found will be destroyed. It is hoped also that scouting may be done along the state line from Thompson westward to the Connecticut River and southward to the Sound. Though it will be impossible to eradicate the brown-tail moth, as can be done with isolated colonies of the gypsy moth, the former can be more readily controlled, and is not such a serious pest of vegetation as the latter, though very troublesome to humans on account of the poisonous and irritating hairs that break off from the caterpillars and adults.

As this insect is now present in Connecticut, a description of its different stages and its injury is given here, so that people may recognize it.

The Adult Moths.

Both sexes have the same color and markings, but the male is smaller than the female and has a more slender abdomen. Both pairs of wings are pure white, as is the thorax and a part of the abdomen, but the rear end of the body bears a tuft of

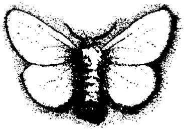

Fig. 10. Female Brown-tail Moth, natural size.

brown hairs which are rubbed off from the female in the process of egg-laying and incorporated with the eggs, and give the egg-cluster a reddish brown color. The female has a wing expanse of one and one-half inches, while that of the male is somewhat less, perhaps one and one-fourth inches. The male has feather-shaped antennæ, tinged with brown, and the forewings are edged with brown on the under side. The female has wings that are white on both sides, and the antennæ are white and much smaller than those of the male.

Both sexes fly, and fairly swarm around electric lights in a badly infested section at the time of their emergence in July. On account of the ability of the females to fly, it is difficult to exterminate an isolated colony. Sometimes, if there is a

storm during the flight of the moths, they are driven with the wind long distances. Many dead moths are found in the globes of the arc lights. The female is shown in Fig. 10.

THE EGG STAGE.

The eggs are usually laid in oval clusters of from 200 to 400 eggs each, and on the under side of a leaf. The eggs are laid the first three weeks of July, and the masses are reddish

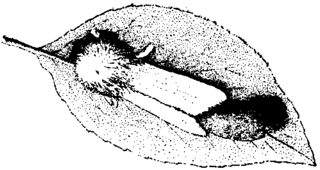

FIG. 11. Egg-mass as laid on leaf by brown-tail moth, natural size.

brown from the hairs of the female moth, and about three-fourths of an inch long. The eggs are spherical, and yellow in color. They hatch in from fifteen to twenty days after being deposited. The appearance of the egg-mass is shown in Fig. 11.

THE CATERPILLAR.

The young caterpillars, after hatching from the eggs late in July or early in August, feed at first on the leaf containing the

FIG. 12. Winter nest of brown-tail caterpillars, natural size.

egg-mass, but later other leaves are devoured. In September a number of leaves are drawn together and fastened and lined with the silk spun by the caterpillars, making a nest (see Fig. 12) in which the larvæ spend the winter, a hundred or more sometimes living in one nest. The larvæ emerge in spring and feed upon the leaves which first appear, and continue to devour

FIG. 13. Brown-tail caterpillar, natural size.

the foliage, increasing in size and molting four or five times until fully grown, and they are about an inch and one-half long when they spin their cocoons about the 20th of June.

The caterpillar is dark brown in color, with light brown hairs. On each side, so that it shows both dorsally and laterally, there is a row of white tufts, one on each segment, and appearing as an interrupted white band when seen from above. On each of the ninth and tenth segments there is a small red tubercle bearing hairs. (See Fig 13.)

THE COCOON.

The cocoon is usually made between folded leaves or in the crevices of the bark or some other sheltered place and is shown in Fig. 14. The pupæ are commonly found in masses more or less

FIG. 14. Cocoon of Brown-tail Moth, natural size.

loosely held together by the silken webs and hairs from the caterpillars. This stage lasts about twenty days, depending somewhat upon the weather conditions.

Methods of Controlling the Brown-tail Moth.

The gypsy moth eggs, after being deposited, remain for about nine months before hatching, and this is much the longest period of any stage of the insect's existence. But with the brown-tail moth the egg state lasts only between two and three weeks, and the larva or caterpillar stage is the long period, during which the important control work must be done. Caterpillars occur on infested trees from August 1st until the latter part of the following June. Control measures are chiefly of two kinds—destroying the winter nests, and spraying the foliage with poison to kill the caterpillars.

Scouting for winter nests should be done when the trees are bare, and any kind of tree pruner with a long handle is advised. The nests are nearly always at the extremities of the twigs, and can be readily seen during the winter months. As they are clipped from the trees they should be gathered and burned. If left on the ground, the caterpillars inside them may keep alive and crawl upon the trees when warm weather comes in the spring.

After the leaves appear, the caterpillars are no longer found in the nests, and the only way of destroying them is to spray the foliage with poison. For this purpose lead arsenate should be used at the rate of 3 lbs. in 50 gallons of water for the young caterpillars, but 5 lbs. should be used against those nearly full-grown.

Natural Enemies.

The most important natural enemy of the brown-tail moth is a fungus, *Empusa aulicæ,* which in certain moist seasons destroys a large proportion of the caterpillars, which may be found dead on the trunks of trees and the stones of buildings and walls. Sometimes large numbers die in their nests. There are a number of native insect enemies and parasites of the brown-tail moth, besides several imported ones, which it is hoped may in time check this insect.

TESTS OF PROPRIETARY INSECTICIDES IN DESTROYING THE ROSY APPLE APHIS AND THE SAN JOSÉ SCALE.

By B. H. Walden.

The Rosy Apple Aphis.

Meriden Experiments. This orchard contained about one hundred and twenty bearing apple trees, and during the season of 1909 the rosy aphis caused considerable injury to the fruit. During the fall many aphid eggs were deposited on the fruit spurs and small twigs, indicating that the pest would again be present during the season of 1910. Plans were made to try late spring spraying to control the aphids. Word was received from the owner, March 30th, that the eggs were hatching, and on the following day spraying was commenced. Four rows of the trees were sprayed with Grasselli's lime and sulphur, 1 gal. to 11 gals. of water. The next two rows were sprayed with "One for All," 12 lbs. to 50 galls. water. On April 6th the remaining two rows were sprayed with Pratt's "Carboleine," 1 gal. to 8 galls. of water. The spraying was done as thoroughly as possible, using a large pump with the pressure averaging about 125 pounds.

The trees which were sprayed the week before were examined, and while many dead aphids were found, others were alive even on buds that were thoroughly coated with the lime and sulphur. Conditions were about the same where the "One for All" was used, though it was harder to tell if the twigs had been as thoroughly coated as those sprayed with the lime and sulphur.

As the season advanced the aphids disappeared from apple trees so that no final conclusions could be reached regarding the treatment.

Station Experiments. During the fall of 1910, eggs of the rosy aphis were observed on the small apple trees at the station. Rarely more than six or eight eggs were found on a twig, but from past experience, even where such small numbers have been present on the twigs of bearing trees, the aphids upon hatching will multiply sufficiently in a season favorable to their development to seriously check the growth of the fruit. The eggs were in crevices around the fruit spurs, or the buds and base of branches on the prev

On November 30th eighteen of these trees were thoroughly sprayed with Niagara lime and sulphur, one part in eight parts of water, to note the effect on the eggs. Certain twigs were tagged where the eggs were most abundant. Some of these twigs, which were still well coated with the spray, were examined the first week in January. Most of the eggs were apparently alive, showing no effect from the treatment, although it will be necessary to examine the eggs at hatching time to learn the efficiency of the treatment.

San José Scale.

Meriden Experiments. In connection with the experiments against the rosy aphis in the Meriden orchard, the effect on the scale was also observed. This orchard had been sprayed in previous seasons to kill the scale, and while it was present, only a few trees toward the lower end of the orchard showed much scale in the spring of 1910.

The orchard was visited on November 15th and the effect of the treatment on the scale was noted. Very little living scale could be found on the trees sprayed with the lime and sulphur, and while there was less scale on these trees in the spring, considerable dead scale could be found at the time of examination.

Trees sprayed with "One for All" showed the most living scales. Two of these trees, which must have been well coated in the spring, had branches encrusted with them. The scales were present on the petioles of the leaves, and were noticed on the fruit at picking time.

Many living scales were found on the trees sprayed with "Carboleine," which was rather surprising, as the mixture was used much less dilute than is generally recommended.

A young orchard of apple and peach trees adjoining the one in which our experiments were conducted was sprayed with Grasselli's lime and sulphur during the later part of March. Here many of the trees were quite badly infested with scale, but in November very few living scales were seen.

Station Experiments. Five preparations were applied on April 13th to a block of small trees on the station grounds to note the effect on the San José scale. The trees, principally apple and peach, and moderately infested with scale, were set rather closely in rows about four feet apart. A screen was used to prevent the spray from blowing upon adjacent trees treated with different

preparations. The buds were opening and a few leaves were out when the applications were made.

Grasselli's Lime and Sulphur. Used at the rate of 1 gal. to 11 gals. of water: Eighty-two trees were sprayed. No injury to the opening buds. No living scales on twigs examined June 30th.

Crowley's "Arbolineum." Used 1 part to 8 parts of water. Considerable injury to buds and young leaves showed the following day. No living scales on twigs examined June 30th. The trees showed the effect of injury throughout the season.

"One for All." Used at the rate of 12 lbs. in 50 gals. water. No injury to buds followed the treatment: 2.2 per cent. of living scales were found on twigs when examined June 30th.

Vreeland's Scale-Killing Compound. As no directions were given with this preparation, it was used at the rate of 1 gal. in 8 gals. water. Warm water was used, as it did not mix readily with cold water. This preparation did not injure the buds. When twigs were examined June 30th, 17.4 per cent. of the scales were found to be alive.

Bogart's Sulphur Compound was used 1 part to 15 parts of water. There was no injury to buds, but 2.7 per cent of the scales were found to be alive when the twigs were examined June 30th.

On November 30th, twenty-eight of the small apple trees were sprayed to kill the scale with Niagara lime and sulphur, 1 part in 8 parts of water. An examination of the scales February 28th showed 2.6 per cent. of the scales alive.

EXPERIMENTS ON STATION TREES, APRIL 13, 1910.

Kind of trees.	Number of trees treated	Condition of trees before treatment.	Materials applied.	Percentage of Scales alive after treatment.
Apple Peach	69 13	Moderately infested " "	1 gal. Grasselli's Lime Sulphur 11 gals. water.	0.%
Apple Peach	22 14	" " " "	1 gal. Crowley's "Arbolineum" 8 gals. water.	0.%
Apple Peach	37 9	" " " "	1 lb. "One for All." 4 gals. water.	2.2%
Apple Peach	60 13	" " " "	1 gal. Vreeland's Scale Killing Compound 8 gals. water.	17.4%
Apple Peach	78 12	" " " "	1 gal. Bogart's Sulphur Compound 15 gals. water.	2.7%
Total	327			

A PHORID (*Aphiochæta rufipes* Meigen) INFESTING ONION SEED.

By B. H. WALDEN.

Specimens of a small maggot from the seed-testing department were brought into the laboratory on October 28th for determination. These were taken from onion seeds which had been put in the germinator to test their vitality The maggots were first observed in three or four days, or soon after the seeds had begun to sprout. They soon ate out the interior of the seeds and were present in such numbers that it was impossible to obtain any data regarding the vitality of the seeds. Spinach and grass seeds which were in the germinator were not attacked, so the first supposition was that the onion seeds were infested when put in to test.

A re-test was made from the same lots of seeds (seven in number) and no maggots were found in these. A third test showed no infestation, which seemed to contradict the idea of the seed being infested before being placed in the germinator. The one in charge of the seed testing had not ohserved any similar insects in seeds before.

An examination of the germinator showed a chance for small insects to readily enter it through the slide provided for ventilation, and which was often open. Even the large door of the germinator was sometimes left open to lower the temperature.

All of the infested material was removed in the blotters to the entomological laboratory and placed under a bell-jar with the moisture and temperature regulated as far as possible to correspond with that of the germinator. The seeds and blotters were carefully examined to find the egg of the insect. One small oval white egg was found on a seed, and two similar eggs were found on the blotters. As these did not hatch it was not proven that these were the eggs of the insect.

In about ten days from the time the seeds were first placed in the germinator a number of the larvæ pupated.

The first adult emerged November 21st, twenty-four days after the pupæ were first observed, and proved to be a small two-winged fly, *Aphiochæta rufipes* Meigen. This insect belongs to the family Phoridæ, a group of flies, the larvæ of which infest decaying vegetable and animal matter, such as fungi, insect

cocoons, dead caterpillars and snails, exhumed human bodies, etc. These flies are readily recognized, being quite small and very active. Many of them have the "hump-backed" appearance shown in the drawing representing this species, Fig. 15. The Phoridæ are separated by the peculiar wing venation and shape

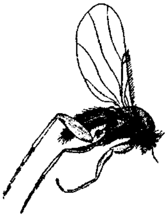

FIG. 15. Adult male of *A. rufipes*, enlarged.

of the antennæ. The above species is one of the more common and widely distributed species and is a very general feeder.

With the temperature of the germinator at about 86 degrees F. throughout the day and the excessive amount of moisture needed to start germination, caused the onion seed to give off an odor which would naturally attract insects of this nature. Seeds with no such fetid odor would naturally escape infestation by this insect. A number of these flies must have been present at the time the first lot of seed was placed in the germinator. After depositing eggs, the adults probably all died before the next lot of seed was started.

It was not learned how the insect was brought into the place though there was considerable dried vegetable matter in the laboratory, quantities of seeds, sacks with dried alfalfa hay, etc.

Egg. The egg found on the onion seed was shiny white in color, of an oval shape, tapering gradually toward the ends. Length .53 mm., width .019 mm.

Larva. General color, white, apparently caused by the fatty tissues seen through the transparent skin. Lateral edges nearly transparent. Length 3.79 mm., greatest width 1.017 mm., tapering toward either end, narrowing most toward the front. The segments not well defined, excepting when the larva crawls.

The first segment with two pairs of nearly equal, pointed tubercles which appear to be two-jointed. A lateral tubercle present on this and all other segments. Last segment with four tubercles corresponding to those on the first segment, the central pair smaller than the ones on either side. The second and third seg-

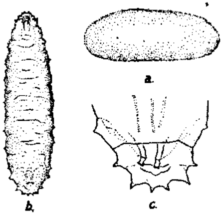

FIG 16. *Aphiochæta rufipes.* a, egg. b, larva. c, posterior extremity of larva.

ments with four small dorsal tubercles near their front margins. On the second segment back of the four tubercles is a pair of slender nearly black tubercles. The last segment is provided near its base with a pair of large, blunt, yellowish tubercles.

Pupa. Yellowish, changing to a dull brown color. About a week before the adult emerges the legs, antennæ, etc., can be

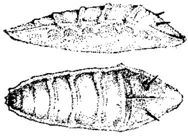

FIG. 17. Dorsal and lateral view of pupa of *A. rufipes* enlarged.

seen through the pupa skin. Length 3.17 mm., width 1.149 mm. The widest portion is at the apical fourth, from which it tapers sharply toward the apex, this part forming a triangle. It is narrowed much more gradually toward the rear with the anal end rounded, the four anal tubercles being well defined. The sides are depressed dorsally, forming a sharp margin. The thorax is

provided with a pair of long slender black processes, corresponding to the pair of slender blackish tubercles, on the second segment of the larva. Laterally the pupa tapers more sharply toward the apex than it does toward the anal end. The general dorsal profile is more curved or bent than that of the ventral surface.

Adult. The head, antennæ, thorax and abdomen are black, the upper surface of male with conspicuous brownish black bristles which are absent on the abdomen of the female. The legs vary from brownish to reddish yellow. The wings are transparent, with very long bristles on the costal vein (the upper edge). Length 2.5-3 mm.

The species is widely distributed throughout the United States.

Remedies. Such an infestation could probably be prevented by having a fine wire cloth screen over the ventilator of the germinator. Material in which the insect is liable to breed should not be stored near the germinator.

A PYRALID CATERPILLAR ON NURSERY STOCK FROM JAPAN.

Hemiscopis cinerea Warren.

During the season of inspecting imported nursery stock on April 12th Mr. Walden found in a shipment of ornamental shrubbery from Japan some caterpillars on a deciduous shrub resembling lilac. All specimens that could be found were placed in a tight jar and carried to the laboratory for study. As they were nearly full-grown, they pupated in a short time. About June 10th the adults began to emerge, and in a week or so eight specimens had appeared. On November 4th one of these was sent to W. D. Kearfott for identification, and he replied in part as follows: "Your letter of the 4th with specimen of Japanese Pyralid safely received, and I have examined all of my literature trying to find the name of it and without success, and will have to send it to London for determination. The specimen is a female. Will you please look through any others you may have and see if you can find a male? If you will forward the male, I will send it over to Hampson, and he is usually very prompt in replying, so that you can expect action within a month."

Additional specimens were sent to Mr. Kearfott on November 21st. He acknowledged them, and sent a pair to Sir George Hampson. A month later Mr. Kearfott wrote: "I have just heard from the British Museum and secured the name of the Pyralid bred from Japanese nursery stock,' which in your letter of November 4th you stated was lilac or some closely allied deciduous stock. The species is *Hemiscopis cinerea* Warren, belonging in the sub-family Pyraustinæ. This species was described in the Annals and Magazine of Natural History, Series 6, Volume IX, page 396, from Japan. It is referred to (by name only) by Hampson in Proceedings Zoölogical Society of London, page 223, 1889."

The following brief descriptions were drawn from the material studied in our laboratory.

Larva. About three-fourths of an inch long, one-tenth of an inch thick. Ground color cream or white, with a light salmon-pink spiracular stripe. Head light chestnut brown, shiny. Thoracic shield, legs, jaws and tubercles dark seal brown, shiny. Thoracic shield divided dorsally by a longitudinal whitish band or a continuation of the body color. The brown tubercles are arranged as follows: four rows show dorsally and the same number laterally, two above and two below the pinkish stripe. A bristle or hair is borne on each of the dorsal tubercles. Shown in Fig. 18.

Pupa. About seven-sixteenths of an inch long, about one-eighth inch thick. Color light brown. Enclosed in case of

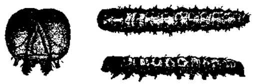

FIG. 18. *Hemiscopis cinerea*, dorsal and lateral view of larva, four times enlarged, and face of same, greatly enlarged.

particles of Sphagnum used for packing, and fastened together and lined with silk.

Adult. Wing-spread from seven-eighths to one inch. Color brownish, somewhat darker in the female, with a violet iridescence on upper surface of both wings: a darker V-shaped mark

extending across both front and rear wing, as shown on Plate XXIX, c. Under surface unicolorous; t-p line and discal spot showing. Legs brown except tibiæ, which are covered with whitish scales. Head and body brown above. Under side of head and fourth, fifth and sixth abdominal segments bearing whitish hairs on the ventral side.

Letters were written to the Bureau of Entomology at Washington to learn whether or not this insect is regarded as a pest in Japan, but it seems not to have been mentioned in the accessible literature except the references given above. I have also written to Professor S. I. Kuwana of Tokyo, who states that *Hemiscopis cinerca* is rather uncommon in Japan, and that so far nothing is known about its life history and that it is not considered a pest there.

CARTRIDGE SHELLS RUINED IN TEXAS BY ANTS.

On February 23d, 1910, a box of paper shotgun cartridges which had been eaten apparently by insects, was sent to the station for examination and study by a manufacturer of cartridges, accompanied by the following statement: "These were returned by a customer in Texas. We do not know how long they had been in his possession, but they were loaded and shipped by us about November, 1906. Any information which you can give us in regard to the damage to these goods would be very much appreciated, and if there is any further information which we can supply you with to assist you in your investigations, please call upon us."

The cardboard shells, and in some cases the wads, had been eaten so that the powder and shot fell out and mixed together. From the appearance of the goods, some being badly eaten and others nearly perfect, it was evident that the insect had used the box of shells as a nesting-place rather than as a source of food.

One of the shells is shown on Plate XXIII, c.

After examining the injured material, the following letter was sent to the manufacturers in reply:

The samples of cartridges submitted by you, and showing the injury by some kind of insects, have been examined, and the letter of Feb. 23d was also received.

I have gone over the injured cartridges with considerable care, and from what I know about the injuries to some other articles by various kinds of

insects, and from their appearance, I suspected at the start that it was caused by some kind of ants.

For instance, on each cartridge one can see where the ants have crawled up and down, having regular run-ways, corresponding to the interstices between the cartridges as packed in the boxes. A very careful examination of the debris gave me a portion of the rear wing of some kind of an ant, and also in another place I found an ant's head. These, of course, do not enable me to identify the species, but merely serve to show that the box has been infested by ants.

A few years ago a new kind of ant appeared in the vicinity of New Orleans, and caused great damage to all kinds of stored food products, as well as other articles of commerce. This ant has the peculiar habit of making its nest in almost any kind of material. In one case on record, a nest was found between the metal oil can and its wooden jacket. The ants therefore have used this box of cartridges as a nesting place, and the injury was not done on account of the food which they expected to obtain. At least this is my interpretation of it.

This particular species of ant which I refer to as being introduced around New Orleans is called the Argentine ant, and its scientific name is *Iridomyrmex humilis* Mayr. It is supposed to have been brought in some way in ship loads of coffee from South America, and has spread over the southern half of Louisiana, and no doubt has gone into Texas.

Of course I am not certain that this particular kind of ant did the injury, but it is very probable, and in case you wish to read up about the history and habits of this depredator, we have plenty of literature regarding it in our laboratory.

Since writing the above letter I have looked up the published articles on the Argentine ant to learn of its distribution. I have no knowledge that the species actually occurs in the state of Texas, yet it was reported by Newell* as being near the Louisiana-Texas line in 1908, having spread westward from New Orleans, where it was first seen in this country by Mr. Foster in 1891, and reported in literature by Titus in 1904.† It is entirely probable that the pest is now present in some parts of Texas, as its spread is liable to be rapid, especially if shipped with infested goods along the lines of the railroad. On the other hand, the cartridges may have been stored in Louisiana and have become slightly infested before they were shipped to Texas.

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* *Journal Economic Entomology*, i, 21.

† Bureau of Entomology, Bull. 52, 79.

THE LEAF BLISTER MITE.

Eriophyes pyri Nal.

This pest is not an insect, but is a small animal belonging to the Arachnida, the same class containing the spiders. It is commonly known as the pear leaf blister mite, and forms small blisters or galls on the under sides of pear leaves in early summer. In bad cases the blisters are not wholly confined to the leaves, but sometimes occur on the soft twig-growth and on the fruit. At first the blisters are light green, but they soon turn red, and later brown, as the cell tissue dies in these spots. Where abundant, the injury causes the leaves to drop. This mite has long been known as a pest of pear, but only recently has it been recognized as an important apple pest on account of the serious injury which it has caused in the state of New York. It has there been studied by Professor P. J. Parrott, entomologist of the Agricultural Experiment Station at Geneva, who has found several other species causing similar blisters, and has described one of these as new. But none of these species do as much harm as *E. pyri,* and the practical orchardist need not consider them at all, as the method of controlling the pear leaf blister mite will also keep them in proper check.

During the past summer the work of this mite on apple was noticed on several trees in the orchard of E. M. Ives at Meriden, and Mr. Walden states that he saw it there in 1909. It has been sent to the station during the summer (on apple) from Litchfield, New Britain and Ellington. A sample was also received from Cummington, Mass., and from what the writer saw of it in western Massachusetts in August, it seems to be capable of considerable injury, as certain trees had lost at least one-third and possibly one-half of their leaves because of it. Much damage has been done by it in New York state, and it has caused more or less injury in Massachusetts, Pennsylvania, Illinois and Ontario, Canada. In New York state especially, the damage has increased to such an extent that for the past few years no insect attacking the apple, except the San José scale, has attracted more attention or provoked more discussion among growers than has the leaf blister mite. See Plate XXIII, b.

The mite passes the winter under the bud scales, and the most favorable times to reach it by spraying are in late fall after the

leaves drop and in early spring before they appear. Professor Parrott's investigations regarding treatment were extensive, and were conducted in eleven different orchards. He found that the mites could be killed by spraying at the times mentioned above, either with a lime-sulphur mixture or with a miscible oil, but with the many excellent commercial lime-sulphur mixtures on the market, he prefers one of them to other forms of treatment. It will be seen that where this treatment is given to destroy the San José scale, it will answer for the leaf blister mite as well, and if on pear trees, the pear psylla will also be controlled.

A PEST OF BIRCH TREES IN CONNECTICUT.

Bucculatrix canadensisella Chamb.

Everyone traveling by steam or trolley cars in Connecticut during the months of August and September, 1910, has probably noticed the widespread defoliation of the slender white, grey, or bobbin birches (*Betula populifolia*) throughout the eastern part of the state. Especially was this devastation noticeable in Tolland and Windham counties, and I am told that it extended far into Rhode Island and Massachusetts. In the northern part of New London County, and especially around Norwich, this trouble was observed early in September. Over much of this area nearly every tree was stripped of leaves, and in some cases acres and acres of brush land presented a denuded appearance. In riding from Willimantic to New Haven via Hartford the trouble was not very noticeable south of Hartford, though trees here and there were attacked. The writer observed it at New Canaan and around New Haven, where an occasional tree was attacked and perhaps partially stripped, but most of the trees were uninfested. Messrs. Walden and Champlain observed the trouble at Cromwell and at Stratford.

The insect responsible for this condition of the trees is a small moth of the family *Tineidæ* called the birch bucculatrix, or birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb. It is closely related to the apple bucculatrix or ribbed cocoon-maker of the apple, *B. pomifoliella* Clem.

The adult moth is brown, prettily marked with white, as shown in Fig. 19, and has a wing expanse of about three-eighths of an inch. The following description is by Dr. James Fletcher:

"Moth small, wings expanding ⅜ of an inch. General color, bright brown, the wings crossed with silvery white bars; three of these run from the outer edge about half way across the wings obliquely towards the apex, and there two shorter subtriangular blotches on the inner margin of each forewing. These latter, when the wings are closed, form two white dorsal saddles, the anterior of which is slightly the larger, and is followed closely by a tuft of raised black scales. At the extremities of

FIG. 19. *Bucculatrix canadensisella*, adult moth, greatly enlarged. (Redrawn from Packard, Insect Life, Vol. V, p. 14.)

the forewings are also several raised black scales, a few of which are separated into an apical spot by an irregular narrow white band. The cilia of the fringes are pale brown, head white; frontal tuft dark brown in the center; antennæ brown, slender, about ⅛ of an inch long. Thorax brown with margins, including the bases of the forewings, white. Legs and body pale fuscous, silvery."

Little appears to be known about the life history and habits of this insect, and no description of the egg could be found in its literature, though Dr. Felt mentions* the mining operations of the larvæ, which he states have not been observed. At the time the insects were feeding upon the trees I supposed that the species had been more carefully studied, and as we were busy, I neglected to make descriptions of the larval stages, though material was abundant. The caterpillars are only about a quarter of an inch long when fully grown. They are greenish yellow and feed upon both sides of the leaf, eating away the soft green tissue or parenchyma, leaving only the skeleton, which turns brown, and the leaf falls prematurely. There are many small circular whitish cocoon-like objects on both sides of the leaves. These are called pseudo or false cocoons, or molting cocoons, and serve as shelters during the molting period. The larva suspends itself by a thread when disturbed. The following description of the larva is taken from Packard's article in *Insect Life*:†

* Insects Affecting Park and Woodland Trees, p. 315.

"*Larva.* Length 5 or 6 mm. The head is about two-thirds as wide as the body where thickest; it is pale honey-yellow. The body is long and slender, tapering regularly towards each extremity; the anal legs are rather large, project well behind the body, and diverge in creeping. The body is pale honey-yellow, with sometimes a slight greenish hue. The hairs are fine, scattered, arising from small pale warts; besides the four dorsal warts, which are arranged in a regular trapezoid, there is a lateral one visible on each side. The surface of the prothoracic segment is large and hroad, though not so wide as the second thoracic segnent; about six hairs project from the front edge. The segments are all very distinct, the sutures being deeply impressed, while the hinder edge of each segment is slightly raised and thickened. The second and third thoracic segments are much shorter than the prothoracic, while the first and seventh abdominal segments are longer, at least two-thirds, than the eighth. The ninth abdominal segment is much narrower than the eighth, and narrows posteriorly. There are four pairs of middle abdominal legs, and they are of the same color as the body. The oval cylindrical yellowish testes(?) are distinctly visible under the skin of the fifth abdominal segment."

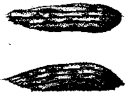

FIG. 20. Dorsal and lateral view of pupa of *Buccalatrix canadensisella*, five times enlarged.

The true cocoon (shown in Fig. 20) is about one-eighth of an inch long and nearly one-third as broad as long. The shape is that of a flattened cylinder with the ends curved downward, the surface being corrugated or ribbed. The number of ridges in our specimens varies from six in most cases to even eight in others. The cocoons are made on the birch leaves, though Packard records finding them on the leaves of wild cherry.*

The birch bucculatrix was noticed injuring yellow birches in New York state in 1886, and again in 1891. In Canada, and in Massachusetts and Rhode Island from 1890 to 1892, it did considerable damage to grey, paper and yellow birches. Felt† states that it was very abundant in New York state in 1901, and skele-

* *Insect Life*, v, 15.

† Insects Affecting Park and Woodland Trees, p. 715

tonized the leaves of birches over large areas. The writer obeserved the work of this insect in New Hampshire on yellow birch, probably nine or ten years ago, but in his residence of nearly seventeen years in Connecticut, never before has he seen such an outbreak. According to Mr. Caffrey, some of the birches around Amherst, Mass., were stripped in 1909. Mr. Thompson writes* that this insect was observed in 1910 on birches throughout Rhode Island and eastern Massachusetts as far west as Springfield and north to Manchester, N. H., and to about twelve miles west of Nashua, N. H. It was also reported from Maine, at Waterville, and as far east as Augusta.

I have received several inquiries regarding the probable effect of this attack upon the trees. A single defoliation, coming as it does so late in the season, would not seriously affect the trees, but if continued each year for several years, might kill them. However, if some of these native grey birches should die from the attacks of this insect, the farmer would no doubt consider it more of a blessing than a curse. But as it does not confine its attacks to this species, considerable damage might be done to the other birches, some of which are valuable for timber and for fuel. Cut-leaf and other birches planted for shade and for ornament should be sprayed next year in July with lead arsenate, 3 lbs. in 50 gallons of water, to forestall further injury.

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Britton. *Connecticut Farmer*, September 24, 1910; *Jour. Econ. Ent.*, iii, 435—1910.

Thompson. *Jour. Econ. Ent.*, iii, 436—1910.

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* *Journal Economic Entomology*, iii, 436.

THE 15-SPOTTED LADY BEETLE.

Anatis 15-punctata Oliv.

The 15-spotted lady beetle was unusually abundant in 1910, especially on apple trees. In one orchard in the town of Orange the writer noticed from fifteen to twenty yellow clusters, containing altogether several hundred eggs, on nearly every tree. Similar conditions were also observed in Meriden and other places. In 1909 the writer found this lady beetle abundant in New

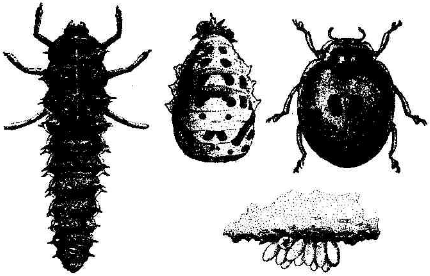


FIG. 21. The 15-spotted Lady Beetle in all its stages, enlarged about four times.

Canaan, where it was apparently feeding upon the aphids (probably *Callipterus betulæcolens*) on a cut-leaf white birch on private grounds. The rosy apple aphis was extremely abundant in apple orchards in 1909 and comparatively scarce in 1910, and it is probable that the 15-spotted lady beetle played no unimportant part in checking this destructive plant louse. The eggs are laid in clusters of ten or twelve, usually on the under side of the large branches of the tree. They are light yellow, and are oval in shape. The larva is very active, and crawls about on the bark and over the leaves, catching and devouring the plant lice. It is larger and darker in color than most lady beetle larvæ. In fact, it is nearly black, save for a fine whitish line extending longitudinally over the back of the thorax, and a broad lighter stripe running along each side of the body. Each segment bears a row

of rather short, stout spines. The pupa is fastened by its posterior extremity to the bark or to the surface of a leaf, and is at first a cream color, marked with brown spots, but soon becomes darker. The adult beetle is about three-fourths of an inch long, and at first is a light reddish yellow, marked with nearly circular black spots. There are eight of these spots on each wing cover, but those on the inner margin at the base are often confluent, and appear as a single spot, hence the name. The thorax has a black patch with two light spots near the base of the wing covers, and a broad light margin bearing laterally two irregular black spots. As time goes on, after the beetle emerges from the cocoon, it gradually grows darker until the spots become very indistinct. Some of the specimens in the station collection appear to be a uniform dark brown color, though if examined carefully the spots may be discerned. The appearance of the egg, larval, pupal and adult stages may be seen in Fig. 21.

This lady beetle is very beneficial and should not be destroyed. Like most of the related species native to Connecticut, it feeds in both the larval and adult stages upon plant lice or aphids. Only one lady beetle found in the state is injurious, and that feeds upon squash vines. All the others should be encouraged rather than destroyed.

BRIEF NOTES.

Cabbage Looper. *Autographa (Plusia) brassicæ* Riley. This insect has been rather common for two seasons, and in some fields has actually caused more damage than the imported cabbage worm *Pontia rapæ* Linn., from which it can be distinguished by its lighter green color, smooth skin, and body tapering toward the head. It also "loops" or "measures" when it crawls, like the larvæ of the Geometridæ, because there are no prolegs on the sixth and seventh abdominal segments. The caterpillars often attack other vegetables, including celery, parsley, cauliflower, turnip, lettuce, dandelion and tomato, and sometimes get into greenhouses late in the fall and damage plants by devouring portions of them.

The caterpillar is from one to one and three-eighths inches long, and in color is light green, indistinctly striped with white. The adult is a dark brownish grey moth, having a wing expanse of about one and one-half inches, with a silver dot and U-shaped mark near the middle of each forewing.

There are two broods each year, and damage in the cabbage field may be prevented by spraying the plants with lead arsenate, 3 lbs. in 50 gallons of water, as for the imported or common cabbage worm.

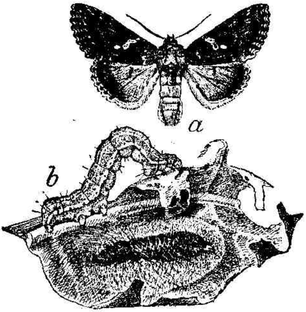


FIG. 22. Cabbage Looper, *A. brassicae*, showing adult, larva, and pupa stages, natural size. (After Chittenden, Bureau of Entomology, Bull. 33, U. S. D. A.)

Cottonwood Leaf Beetle. *Lina scripta* Fabr. This beetle is quite a pest in certain regions of New York and other states where basket-willows are grown, and for many years it has been known as a serious enemy of cottonwood in the Middle and Western states. Until the past season we have never taken it in Connecticut, nor had it reported as occurring here. While inspecting nurseries in September, Messrs. Walden and Champlain found this insect quite abundant at Stratford and at Buckland, feeding on Carolina poplar. At the latter place all stages were observed, though the pupæ were much the most abundant. Nearly all of the Carolina poplar trees in the nurseries at these two places were infested by this insect.

Mr. Champlain also found another species, *Lina interrupta* Fabr. (*lapponica* Linn.), very abundant and feeding upon alders at Lyme in May. Both of these species taken in the state during 1910 were not previously represented in the collection, and had

not been reported to this office as occurring in the state. Either may at times injure ornamental trees and shrubs, but probably will not cause widespread damage. Spraying the foliage with lead arsenate is the best remedy.

Arbor Vitae Attacked by Red Cedar Bark Beetle. *Phlœosinus dentatus* Say. On August 1st sections of the trunk of a small arbor vitæ tree which seemed to be nearly dead were received from a nearby nursery. Under the bark were numerous small adult beetles with their larvæ and pupæ. Many galleries had been cut in various directions through the cambium, thus cutting off the flow of sap and effectually girdling the trees. The beetle is only one-sixteenth of an inch long, is brown or black in color, and has long been known to attack injured red cedar and white cedar, or arbor vitæ trees. There is little to be done to save the trees that are once attacked.

Maple Leaf-Stem Borer. *Priophorus acericaulis* MacG. Work of this insect was received from correspondents in Rockville on May 25th, and from Meriden on June 4th. Several years ago this insect did considerable damage by defoliating sugar maple trees in New Haven, and after repeated efforts the adult was finally obtained and proved to be a new species. It was described under the name given above by Dr. A. D. MacGillivray in *Canadian Entomologist*, vol. xxxviii, p. 306. The life history was worked out by the writer and published in *Entomological News*, vol. xvii, p. 313—1906. Since this date I have not seen the work of this insect until receiving the samples herein mentioned.

Rhododendron Lace Bug. *Leptobyrsa explanata* Heid. Rhododendrons are being injured, in some cases rather seriously, by a species of lace bug belonging to the family Tingitidæ, which has recently been described by Heidemann.* It lives on the foliage of mountain laurel and the native rhododendron, *R. maximum*, and has recently been injuring the cultivated varieties. The insect has been reported by Heidemann as occurring from Boston along the Atlantic seaboard to Florida. The insects occur in the nymph and adult stages on the under side of the leaves, where they suck out the sap. On leaves badly attacked a whitish spattered appearance is more or less prominent on the upper surface, injuring the appearance of the foliage. On the under surface are numerous brown dots, which are the excrement of the insect. Infested

leaves have been received from Rockville, South Manchester, Middlebury, and New Haven. The proper remedy is to spray the under sides of the leaves with kerosene emulsion or whale oil soap and water.

Grape Root Worm. *Fidia viticida* Walsh. This insect, which has done so much damage to vineyards of New York state, has not been conspicuous in Connecticut, but on June 28th leaves were received from Stamford showing the characteristic chain-like marks where the adult beetles had eaten the upper surface. The larvæ feed upon the roots, and thus greatly weaken the vine. The beetles are about one-fourth of an inch long, and are rather plump brown beetles, closely covered with very short grey hairs. It is a difficult insect to control, and where abundant, cultural methods, together with collecting the beetles and spraying with arsenical poisons, must be practiced.

June Beetles Defoliating Poplars. On June 13th two June beetles were received from South Lyme with the statement that they were very abundant and were defoliating Carolina poplars. The specimens belong to the genus *Lachnosterna,* the members of which are commonly known as May beetles or June beetles. The exact species has not been ascertained.

Clover Seed Chalcid. *Bruchophagus funebris,* How. A sample of clover seed was submitted to this department by Miss M. H. Jagger, seed analyst of the station. These seeds were infested, and the insect appeared to be the clover seed chalcid. This insect is distributed nearly all over the United States, and in some localities is a serious pest. The eggs are laid on the clover heads in the field, and the adult four-winged flies emerge from the ripened seeds. Early cutting of clover is a preventive.

Caterpillars on Fir from Japan. When inspecting imported nursery stock, some peculiar nests were noticed on a species of fir, *Abies tomomi*, and on examination, each was found to contain a caterpillar about an inch long. The body color was dirty white, with a ring of dark grey spots on each segment, almost forming a band or girdle. Head brown. Inflated larvæ were sent to the Bureau of Entomology at Washington, but could not be identified by anyone there. The plant was placed in a cage, and the caterpillars ate off nearly all the leaves. The specimens pupated, but we did not succeed in obtaining the adult moth.

Currant Span Worm. *Cymatophora ribearia* Fitch. On June 16th specimens of caterpillars were received from West Hartford feeding upon currant leaves. They were nearly fullgrown, and were whitish, with a wide yellow stripe along the back and a similar stripe along each side, with several black spots of different sizes on each segment. Length about one inch. There is but one generation each year, and the adult is a pretty yellow or tan-colored moth with suffused spots and markings of dark brown. It has a wing expanse of about one and one-quarter inches. Probably it will not become a pest, but if abundant, lead arsenate sprayed upon the leaves will control it.

Cluster Fly. *Pollenia rudis* Fabr. On March 5th samples of flies were received from North Stonington, with the statement that they were extremely abundant in the library building there. The fly is larger than the common house fly, and proved to be *Pollenia rudis*, a very common species which has the habit of entering unused dwellings or other buildings in large numbers late in summer and hibernating there, often becoming a great nuisance. The literature of this office contains accounts of its occurrence in several different parts of the country, though its early stages have evidently not been studied.

Pyrethrum, or insect powder, if fresh, and blown upon these flies with a powder gun or bellows, will stupefy them so that they will drop to the floor and can then be swept up and burned.

Abundance of Mocha-Stone Moth. *Melalopha inclusa.* The caterpillars of this insect feed upon the different species of poplar and willow, and were this past year more than usually common. They were observed in several different sections of the state when our men were inspecting nurseries, and considerable material was gathered. The caterpillars are gregarious and make nests or webs which remain upon the twigs and somewhat resemble the winter nests of the brown-tail moth. If examined, however, they are empty except for a few cast skins. The caterpillars do not pass the winter in them.

Scale Insect on Ferns. *Hemichionaspis aspidistræ* Sign. On March 12th, 1909, samples were received from Milford, mostly males, and on both sides of the fronds of the Boston fern. Mr. Walden found the same species on Boston fern in a large greenhouse in Cromwell on January 20th, 1910. It occurs on various plants in greenhouses, and out of doors in India, Ceylon, Brazil

and France. In India and Ceylon it is regarded as an important pest.

Caterpillars Feeding on Barberry. In August, 1908, specimens of caterpillars were received from Norwich feeding on the leaves of common barberry. They were black with white dots, and unfamiliar to us. We tried to rear the adult moths, but failed. In 1910 a large number of the same kind of caterpillars were collected and observed on Japanese barberry (*Berberis Thunbergi*). They were found on the writer's hedge and in several nurseries. Though the pupa stage was obtained, no adults have emerged at the time of this writing.

Curious Rat-tailed Pupae. *Eristalis tenax* Linn. Peculiar pupæ with long tails were received from Coventry on June 27th and from Waterbury on August 8th. This is one stage of the

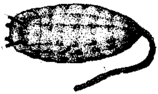
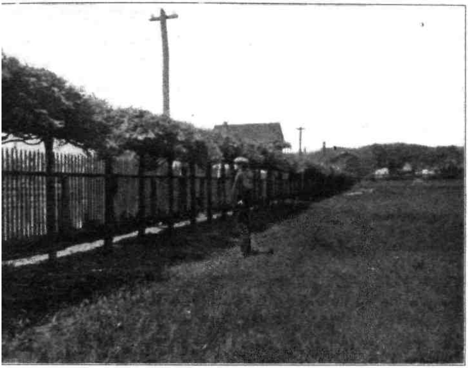


FIG. 23. Rat-tailed pupa of *Eristalis tenax*, twice natural size.

well-known chrysanthemum or drone fly that is so common late in the fall around chrysanthemums in the greenhouse. It resembles a honey bee, and belongs to the family Syrphidæ, many species of which are distinctly beneficial, as the larvæ feed upon plant lice and other injurious insects. The larva of *E. tenax* also has a tail like the pupa, and lives in foul mud and manure. The tail is for respiratory purposes and is shown in Fig. 23.

Thysanurids in Seeds. On October 10th Mr. C. E. Shepard brought to the laboratory some ginseng seeds that he said appeared to be infested with minute insects. We examined several and found nothing, but finally one was found that was filled with spring-tails. Several others were in the same condition. The inside had all been eaten out, and only the shell remained. We do not know whether these insects are responsible for the destruction of the seeds or whether they entered the injured seeds after some other agency had damaged them. The species proved to be *Isotoma* (*Folsomia*) *fimetaria* (L.) Tull. and was

Spring-tails in Tobacco Beds. On March 26th we received from Avon a small vial containing hundreds of spring-tails which were found in a tobacco bed, though not reported as damaging the plants. Such insects are commonly found in gardens, feeding chiefly upon vegetable matter. A few kinds injure plants. Professor J. W. Folsom was kind enough to examine the specimens, which proved to be a species of *Isotoma* which he could not identify without comparing it with European material.

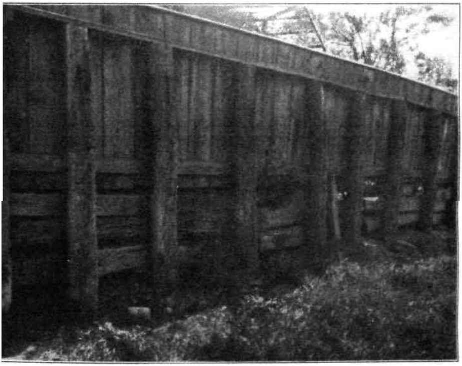


a. Hedge around cemetery after cutting off dead branches.

b. Spraying spruce hedge.

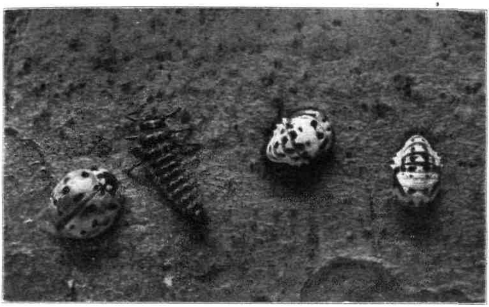
GYPSY MOTH WORK AT WALLINGFORD.

This fence, on Center Street in front of cemetery, contained many egg-clusters.



b. Retaining wall built of old railroad ties infested and replaced with masonry.

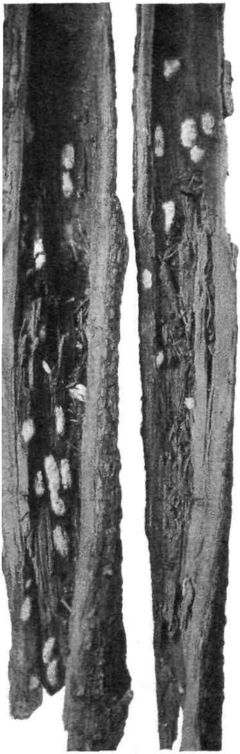
GYPSY MOTH WORK AT WALLINGFORD.



a. Larval, pupal and adult stages of 15-spotted lady beetle, natural size.

b. Pruning and cavity work on maple tree, Main Street, Wallingford.

FIFTEEN-SPOTTED LADY BEETLE: TREE WORK AT WALLINGFORD.



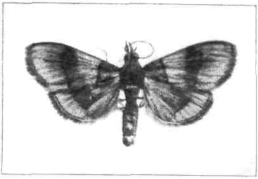
Hollow limb of pear tree containing 49 gypsy moth egg-clusters.

b. Pear leaf showing work of leaf blister mite, natural size.

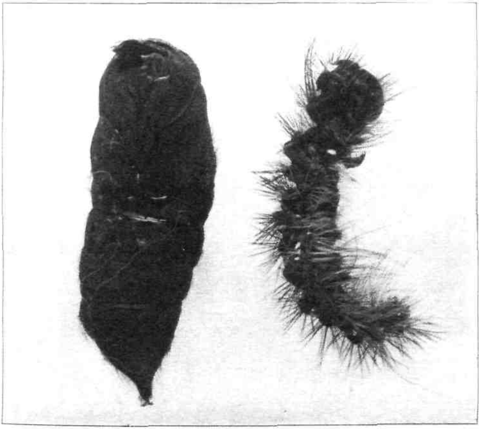
c. Shot-gun cartridge injured by ants nesting in the box.

ITH EGG-CLUSTERS: WORK OF LEAF BLISTER MITE: WORK OF ANTS.

a. Fly *Tachina mella* reared from gypsy caterpillar at Wallingford.



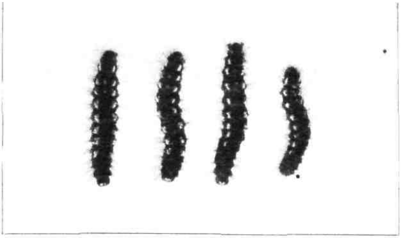
c. *Hemiscopis cinerea*, reared from caterpillar stage, brought in on nursery stock from Japan.



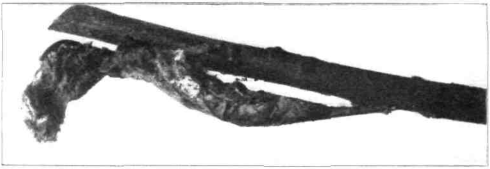
b. Cast skin of gypsy caterpillar showing eggs of parasite and gypsy cocoon from which the fly emerged.

TACHINID PARASITE OF THE GYPSY MOTH: PYRALID MOTH FROM JAPAN.

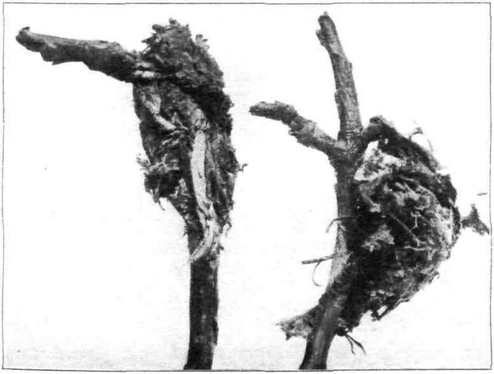
BROWN-TAIL MOTH IN CONNECTICUT.



a. Brown-tail caterpillars, natural size.

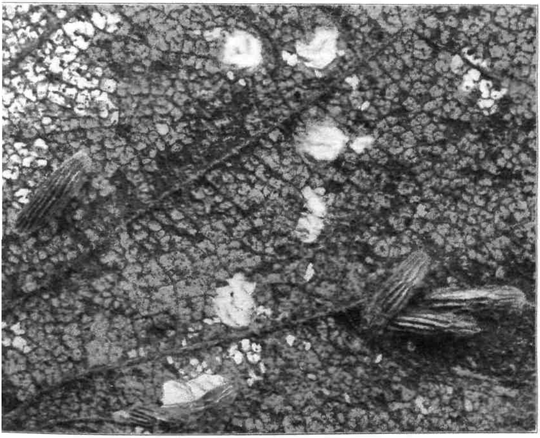


b. Winter nest found on nursery stock imported from France, natural size.



c. Winter nests gathered from fruit trees at Thompson.

a. Skeletonized leaf, showing cocoons, considerably enlarged.



Section of a leaf showing ribbed cocoons and white molting cases, greatly enlarged

WORK OF THE BIRCH BUCCULATRIX.

PART X.

REPORT OF THE BOTANIST FOR 1909 AND 1910.

G. P. Clinton, Sc.D.

I. NOTES ON PLANT DISEASES OF CONNECTICUT.

A. DISEASES IN RELATION TO WEATHER IN 1909 AND 1910.

Weather Conditions in 1909. The winter of 1908-09 was not especially severe, so that trees did not show any unusual injury, except from a couple of ice storms in February, 1909. These storms so heavily coated the limbs that considerable damage resulted, especially to shade and forest trees in the northern half of the state, where the storm was more severe. The spring of 1909 was rather wet and backward, so that such fungous troubles as peach leaf curl, apple scab, etc., that gain their foothold at this time of the year, were unusually prominent.

The summer, however, especially in July and August, like the two preceding seasons, was one of drought, but it was broken in August by rains that prevented serious damage to most of the crops. The late fall proved to be very dry. The first killing frost did not occur until October 13.

Diseases Prevalent in 1909. The following troubles were conspicuous or unusually injurious during this season. *Apple:* Black Rot (Leaf Spot form), Rust, Scab, and Spray Injury (Bordeaux). *Ash:* Rust. *Chestnut:* Bark Disease. *Egg Plant:* Wilt (Fusarium?). *Elm:* Leaf Spot. *Muskmelon:* Leaf Mold, Anthracnose. *Peach:* Brown Rot (spring form on twigs, etc.), Leaf Curl. *Plum:* Black Knot. *Potatoes:* Tip Burn, Scab. *Quince:* Leaf Blight. *Rose:* Rust. *Spinach:* Leaf Mold. *Strawberries:* Powdery Mildew, Winter Injury (root killing). *Tobacco:* Calico.

Of the above diseases the leaf spot of elm, which was quite serious in some places, is discussed later in this Report (p. 717).

The winter seemed in some way to have weakened the spinach crop in the vicinity of Greens Farms, for there were reports that several of the crops there failed because of the subsequent action of the leaf mold fungus described in the Report for 1905, page 275. Mr. Joseph Adams, writing of this trouble, said: "I have a patch of spinach (sown last September in connection with Mr. L. P. Wakeman), which is practically worthless from a black spot which covers the leaves. This is the worst I ever saw. This piece contains about an acre, and we have another piece that is not quite as bad." This fungus was identified by us previously as *Heterosporium variable* Cke., and Professor Thaxter, who examined these later specimens, writes that it was also described by Cooke as *Cladosporium subnodosum* (see Grev. 17: 67. 1889).

Specimens of strawberry plants were received about the middle of June, both from Essex and Naugatuck, with complaints that some trouble was killing off certain fields in those places. Examination revealed no fungus or insect as responsible, but showed that the rootlets were dead, while the crowns were still alive. This was a trouble similar to that seen once before, and discussed in the Report for 1905, page 276. Apparently there was enough life and food in the crowns to put forth leaves in the spring, but with the approach of warm weather these suddenly died off from lack of moisture, etc. The trouble seems to be due to winter injury of the roots, which had either suffered from drought the previous year or else had not been properly protected by snow or mulch during the winter.

Weather Conditions in 1910. The winter of 1909-10 was not especially severe on the whole, though one or two quite cold spells were recorded in January. March proved to be unusually warm and open, and the spring started early, but afterwards cool, rainy weather in May kept back the vegetation so that, as in the preceding spring, it was somewhat backward, and developed an unusual amount of spring fungous troubles. There were two very late frosts, in May and early June, that did more or less injury to fruit blossoms in certain parts of the state, especially cherries, apples and strawberries, and also killed or injured the foliage on certain shrubs, etc., especially in low places. At Windsor we saw small scrub oaks whose leaves were all killed as if by fire. Some injury to coniferous plants was also observed, and no doubt much of the russeting

of apples, so common this year, was traceable in part to these frosts.

Again the summer proved to be one of drought, thus making four years in succession that may be so classed. However, like the preceding one, it was temporarily broken in midsummer by rains that saved most of the crops from serious injury, though potatoes, especially early varieties, were a very light crop. The fall months were unusually dry, and this late drought was not broken until late in December, so that a water famine threatened many communities. As in the preceding year, the first fall frost was delayed until the middle of October, thus favoring the late crops.

Diseases Prevalent in 1910. Among the most conspicuous diseases of the year may be mentioned the following. *Apple:* Rust, Scab, Frost and Spray Injury. *Cherry* and *Plum:* Black Knot. *Chestnut:* Bark Disease, Drought Injury. *Corn:* Smut. *Hollyhock:* Rust. *Maple:* Leaf Scorch. *Muskmelon:* Mildew Blight. *Peach:* Leaf Curl, Brown Rot (chiefly spring infection of twigs, etc.). *Pear:* Scab. *Pines:* Pine-Sweetfern Rust. *Potatoes:* Rot (Blight), Tip Burn. *Rye* and *Barley:* Powdery Mildew. *Quince:* Rust. *Sycamore:* Anthracnose.

Concerning the spray and frost injury of apples, there appears a discussion in Part VII of this Report. There was more peach leaf curl than we have seen before in this state, and while the wet spring favored twig infection with brown rot, this did little harm to the mature fruit except during a wet week in September, when some injury was done to certain varieties in the vicinity of Wallingford. Potatoes suffered most from tip burn, but the rains came so that blight developed slightly on the late varieties and caused some rot of the tubers for the first time in several years. Blight, in late August and early September, carried off many of the melon fields that had not been sprayed.

The effect of successive droughts of the past four years has begun to be manifest on our shade and forest trees, so that an unusually large number of them are dying. This is especially true of the chestnuts, where the blight fungus plays a very important part on these weakened trees.

On the whole, 1909 and 1910, because of their dry summers, were not years in which fungi became especially troublesome,

except those starting during the wet springs. In Parts B and C of this paper we discuss certain diseases that are new to the state, or concerning which special information was obtained.

B. NEW OBSERVATIONS ON DISEASES PREVIOUSLY REPORTED.

APPLE, *Pyrus Malus.*

Spray Injury. Both during 1909 and 1910 there was considerable injury resulting from spraying apples in this state with Bordeaux mixture. As previously reported, this injury was of the nature of leaf spotting and fruit russeting. Experiments conducted in 1910 with different fungicides to replace Bordeaux, because of this tendency to injure, showed that there was danger of serious leaf spotting and subsequent fall with "One for All" (rate 5 or 6 lbs. to 50 gallons of water), and also with "Sulfocide" (rate 1 to 200) when either Paris green or arsenate of lead was used with it, though the injury with Paris green when lime was added was lessened. Even without these insecticides, this strength of "Sulfocide" sometimes produces more or less leaf spotting. Some leaf injury was also caused by Bogart's "Sulphur Compound" used at the rate of 1½ to 50. Practically no russeting or leaf spotting was produced by any of the straight commercial lime-sulphur sprays, with arsenate of lead added, even at the rate of 1½ to 50, except what occasionally occurred in the shape of sun scald on the most exposed side of the fruit. While this rarely occurred, when it did it produced rather serious injury. On the whole, the straight commercial lime-sulphur sprays were the most satisfactory as regards least spray injury. For further information, see Part VII of this Report.

CHESTNUT, *Castanea dentata.*

CHESTNUT BARK DISEASE, *Diaporthe parasitica* Murr. In our Report for 1908, page 879, we gave an account of this trouble. At that time it had been reported in every one of the twenty-three towns of Fairfield County, and in eight towns in New Haven County, making thirty-one towns altogether. At the time of writing this article (March 20, 1911), its known distribution is as follows: Fairfield County, twenty-three towns; New Haven County, twenty-one towns; Litchfield County,

fourteen towns; Hartford County, seven towns; Middlesex County, two towns; Tolland County, three towns; Windham County, one town; New London County, one town. This makes a total of seventy-two towns, of which only seven are east of the Connecticut River. We have no doubt that a more thorough survey of that region would reveal its presence, in an inconspicuous way, in quite a few more towns.

This increased distribution in the last three years may indicate that the disease has spread to those new localities, or it may mean that a more thorough search has revealed its presence, and that it has also become more prominent because of the four years of drought that have occurred, beginning with 1907. There are those who believe, however, that unfavorable weather conditions have nothing to do with the prominence of this disease, which they suspect to be a recent importation into this country from Japan. If this theory is true, then we are just beginning to feel the effects of its devastation in this state. Personally, we have not yet found convincing proofs to cause us to change our views expressed in the above-mentioned Report. These views, briefly given, are (1) that the fungus is a native, weak parasite, usually very inconspicuous in its damage, and therefore rarely noticed; and (2) that the unusual winter of 1904, by severely injuring chestnut trees, gave it a chance to spring into unusual and sudden prominence, which it has since maintained and even increased by reason of four successive years of drought, that have injured not only chestnuts, but many other trees.

We do not, and never have, questioned its seriousness. Trees that have been marked in two localities by the botanical and the forestry departments have uniformly showed injury greatly in excess of that indicated when first examined. If our theory is correct, we do believe, however, with the return of several normally wet years the trouble will gradually grow less rather than more conspicuous as it should if weakened vitality of the trees has *nothing to* do *with its* development.

ELM, *Ulmus americana.*

Leaf Spot, *Gnomonia Ulmea* (Schw.) Thuem. Plate XXXIV. During the summer of 1909 several complaints came to the station of elm trees shedding their leaves where the elm leaf

beetle had not been at work. The most serious injury seemed to occur in the vicinity of Chapinville. At the request of Mr. Walter Angus, manager of the Scoville estate at that place, Mr. Walden first visited there in August, and as he found no insect responsible for the trouble the writer made an investigation early in September to determine if a fungus was the cause of it. By July, or earlier, some of the trees had almost entirely shed their leaves, and later put forth a new crop, and these, when examined by the writer, were quite free from fungous attack. Other trees, however, not originally so severely injured, showed the leaves quite badly infected with the above fungus, and these had been shedding their leaves more or less during the season. Where the defoliation had been rather severe, the young branchlets of the season had also frequently fallen off. While the fungus was present on some trees more than on others, and while some of the fallen leaves showed no sign of the fungus, it seemed quite evident, after a careful examination, that this fungus was primarily responsible for the trouble, but that drought had helped to exaggerate it. The illustration shows the condition as regards foliage of one of the trees photographed by Mr. Walden in August.

The fungus produces very numerous, small, black eruptions on the upper surface of the leaves, and these often merge more or less in small groups. In time the specimens show a whitish or grayish margin around these black cushions, due to the wearing away of the epidermis. We have been unable to find any fruiting stage in any of the specimens we have gathered in different years, as the only known stage produces its ascospores on the fallen leaves the subsequent spring. Infection seems to take place only early in the season, since the trees early denuded did not have their second crop of leaves attacked to any extent. Apparently the weather conditions in the spring determine the character and amount of infection, and these conditions seem to have been unusually favorable in 1909. In 1910, on the same estate in Chapinville, the fungus did practically no harm, though the trees bore a smaller crop of leaves, due to the shedding of the small twigs the previous year and to the death of others that were severely injured.

Spraying the unfolding leaves with Bordeaux would probably control this trouble, though the uncertainty of its appearance would make such a treatment rarely practical

This fungus was placed by Ellis under the genus *Dothidella* as *D. Ulmea* (Schw.) E. & E. It is, however, quite distinct in its microscopic appearance, as Ellis states, from *Dothidella Ulmi* (Duv.) Wint., although the two have ascospores very similar. The latter fungus has its perithecia embedded in a distinct black stroma, and the necks open on the upper surface of the leaves. The former, by the crowding of the perithecia together, has something of the appearance of an imperfect stroma, while the perithecia open on the under surface of the leaves mature their asci later, and apparently have no other stage connected with them.

HEMLOCK, *Tsuga canadensis.*

HEMLOCK-HEATH RUST, *Pucciniastrum Myrtilli* (Schum.) Arth. (I. *Peridermium Peckii* Thuem.) The I stage of this fungus (see Report 1907, pp. 350, 383), which is not uncommon, though rarely abundant, in this state on hemlock, has now been connected by us, through artificial infections, with the II and III stage of the above *Pucciniastrum,* which we found in 1910 for the first time on various species of blueberry and huckleberry. *Pucciniastrum minimum* on cultivated azaleas, also found here (see Reports 1907, p. 392 and 1908, p. 854), is probably not distinct from this *Pucciniastrum.*

PEACH, *Prunus Persica.*

Spray Injury. Sturgis (Report 1900, p. 219) has recorded spray injury to the foliage of peach by Bordeaux and other fungicides used in his experiments to prevent peach rot and scab. He found potassium sulphide to be about the least injurious fungicide when used at the rate of 1 lb. to 50 gallons of water. In our experiments with spraying peaches in 1910, this strength was used, and very little injury, except shot-holes in a few of the leaves, resulted. However, when arsenate of lead (rate of 3 lbs. to 50 gallons potassium sulphide) or Paris green (1 lb. to 100) was added, the most serious injury resulted. Not only were the leaves badly injured by shot-holes, but in time they all fell off. Many of the young twigs were also badly spotted (purplish spots much like those produced by the scab fungus), and some were killed. A few young trees were so severely injured that they finally died.

Very similar results were obtained when either of these insecticides was used with "Sulfocide." This spray, even when used without them, at a rate of 1 to 200 produced more or less injury, and even some on young trees at 1 to 400. With both potassium sulphide and "Sulfocide" the injury resulting from the addition of the poisons was due to the production of a soluble arsenate which burned the tissues.

PINE, WHITE, *Pinus Strobus.*

So-called "Blight." In our Report for 1907, page 353, we described the white pine "blight," which was general that year not only in Connecticut but all over New England. We took the view that it was a physiological trouble due to adverse weather conditions (such as winter, drought, and frost injuries), though there were those who believed that it was of a contagious nature, due to fungous attack. We now have data at hand to prove that we were correct. In general this disease becomes evident by the leaves being killed to a greater or less extent from their tip downward, the dead portion turning reddish brown, and also by the undersized leaves, which remain bunched, due to the failure of the branches to lengthen out.

That the disease is not contagious was suggested strongly in our previous studies, since leaves on one tree may all be badly affected while those of an adjacent tree show no signs of the trouble. This noncontagious nature has been clearly proved by observations made in the station's forest plantation on a lot of white pine trees eight years old, in 1910, from planting. At our request the forester, Mr. Hawes, early in the spring of 1908 had all the diseased trees of this plot marked by permanent stakes. There were one hundred and twenty-four of these so marked, but it seems quite likely that some few that showed the disease slightly at the time were not included. We examined them that fall, and found that their condition on the whole seemed somewhat improved, and that there was no general increase of the trouble, though some trees that had not been marked showed signs of the disease. In July, 1909, and again in November, 1910, careful examinations were made of the plot, and the condition of each diseased tree noted. The comparative condition of these trees as regards foliage is shown

Date of Examination	Diseased, but not marked in 1908	Dead	Not Improved	Improved	Cured	Total
July, 1909.....	24	5	54	38	21	142
Nov., 1910.....	18	6	9	65	44	142

This shows that there has been gradual improvement since the trouble first showed in 1907, and that there has been practically no subsequent spreading of the trouble. That is, in 1910 there were only eighteen trees showing the disease, among the 3,000 to 3,200 in the plot, that did not show it in the spring of 1908. Of these eighteen, at least thirteen were included as questionable; that is, there was not positive evidence that it was this trouble, as the leaves were only slightly affected. No doubt, too, some of these were trees that were not marked originally because they were not badly injured. It is also quite probable that some were trees whose leaves were injured by the frosts of 1910, of which we shall speak later, as the injured leaves were often largely on lower branches. Finally, there was no relationship in position between these trees and those badly diseased.

Concerning the effect of the so-called "blight" on the subsequent growth of the trees, we may state that those that were very badly injured have either died, or remained so stunted in growth that their subsequent usefulness is quite doubtful. Others that were rather severely injured have made some growth, and their foliage condition, especially as to color, has improved considerably, though the leaves often remain more or less stunted and bunched. Those least injured have recovered their normal leaf appearance, but are still somewhat backward in their growth. Some few seem to have almost entirely recovered from the effects, and are scarcely to be distinguished in size and appearance from the surrounding trees that were not injured.

Concerning the cause of the sudden appearance of this "blight" in 1907, we are now quite convinced that it was d to the severe frosts that occurred on May 11 and 21 of th year. We mentioned these as a possible cause in our previo Report, but at that time we had no proof as to their connectic as the "blight" was not called especially to our attention un August. In 1910, however, we saw the same trouble produc on certain pines by the late frosts of May and June of th year. Soon after these frosts we found the leaves of scr

oaks in certain regions entirely killed by the frosts, just as had been the case with the leaves of sycamore trees in 1907. In 1910, however, the frosts were much more local in their effects, and in a given region often killed the leaves only on the lower trees and the shrubs, especially those in low places. Shortly after the last of these frosts we visited the white pine plantations on the Whittemore estate at Middlebury, and here we found not only small oaks and other trees in low spots with injured foliage, but also the young pines in these low places showed "blight" injury on the tips of their leaves. Often a difference of only a few feet in the level of the ground on which these stood determined whether or not they were injured.

We have also noted elsewhere in this Report injury by these frosts to pine seedlings in the seed beds. Whether or not a pine tree is injured by the late frosts seems to be determined by the state of development of the foliage at the time, as well as by the lay of the land and the character of the frost. Previous to 1907 we had some few complaints of pine "blight," which we may attribute to winter injury of the roots, and no doubt drought or other injury to the roots, if severe, produces a similar effect. Hartig, in his Diseases of Trees, English ed., p. 111, notes a similar "blight" trouble in Europe, due to frost and drought injury.

PLUM, *Prunus* sp.

BACTERIAL SPOT, *Pseudomonas Pruni* Sm. This has been reported here before on peach, causing spots on the leaves, and on the plum, causing large black spots on the fruit. In July, 1910, it was seen at the Ives farm, Meriden, for the first time causing a shot-hole spotting of plum leaves, similar to that not uncommon on the peach.

SPRUCE, NORWAY, *Picea excelsa*.

Smoke Injury. During the summer of 1910 the writer saw young spruce trees at East Rock Park, New Haven, that had been injured by smoke from a brick kiln about half a mile distant. The injury occurred suddenly on a day when the atmospheric conditions were just right for blowing the smoke among the trees. The young leaves of this year were killed and subsequently dropped off, but those of the previous year were

not injured. Some other conifers were also slightly injured, but the deciduous trees escaped injury, though in the vicinity of the kiln the maples and other trees are sometimes injured. Previous smoke injury, complicated with drought injury, to asparagus fields in the vicinity of this kiln, was mentioned in our Report for 1908, page 858, and similar injury is claimed to have been caused again this year.

C. DISEASES OR HOSTS NOT PREVIOUSLY REPORTED.

APPLE, *Pyrus Malus.*

Fruit Spot, *Cylindrosporium Pomi* Brooks. Plate XXXIII a. In our Reports for 1905, page 264, and 1907, page 340, we described a fruit speck of apples that formed small, brownish, spots in the skin of apples, being especially prominent after storage. Cultures proved this trouble to be of fungous origin, but as these cultures did not produce a fruiting stage of the fungus, we were not sure of its identity.

More recent study has shown that there are three fungi that occur in fruit spots or specks of apples. One of these is the black rot fungus, *Sphaeropsis Malorum,* which is more commonly known not as a spot trouble, but as a general rot of the fruit, especially on summer and fall varieties following insect injury. This fungus is the one that we have most commonly isolated from the fruit specks of market apples. Ordinarily it does not fruit in the culture media on which we have grown it, and so it was probably largely responsible for the fruit speck we describe in the above reports, though *Cylindrosporium Pomi* was possibly present in some cases. Besides the black rot, we have also occasionally isolated a species of *Alternaria* which seems to be responsible for speck injury, though we have as yet made no inoculation tests to prove this.

The third fruit spot, which we have seen frequently on the fruit before it was gathered from the trees, as well as afterwards, is that caused by *Cylindrosporium Pomi,* which was described a few years ago as a new species by Brooks, who found it responsible for a serious spotting of apples in New Hampshire. This fruit spot on the market apples is usually very difficult to distinguish from that of the black rot. Perhaps the black rot fungus

may finally crowd it out in many cases. However, on certain light skinned varieties, especially seedlings, it shows in the summer as small spots in the skin having a decidedly pinkish or reddish purple color. We have seen roadside seedlings made very conspicuous by it in late fall. In storage the color of the spots is darker. So far we have not seen the fungus in fruit on these superficial spots, and ordinarily they do not seem to reach any considerable size, except perhaps when developed further by the presence of the black rot fungus. In one instance we isolated this *Cylindrosporium* from market quinces, a new host, and we have frequently seen similar spots, showing no fruiting fungus, on quinces before and after picking.

On our oat juice agar medium the fungus forms a large, yeast-like, pinkish colony with no aerial growth, but producing an abundance of spores. With age it turns a darker color, sometimes black, though in such cases it may be due to the presence of another fungus frequently associated with it, which we have isolated, but whose identity has not yet been determined.

AZALEA, *Rhododendron indicum.*

POCKET CURL, *Exobasidium Vaccinii* (Fckl.) Wor. Plate XXXIII b. Galls and hypertrophy caused by this or closely related species are not uncommon in this state on various wild species of the heath family, but this fungus on a cultivated species was called to our attention for the first time in the fall of 1909. Specimens of the above azalea, purchased a few months previously for a private greenhouse, were very badly injured. These plants were apparently infected when purchased, having been grown out of doors in a neighboring state, but did not show the trouble at that time. The disease appeared on the leaves, usually involving the apical part and causing a decided thickening of the tissues. This infected part covered more or less of the leaf, which often became decidedly concavo-convex, as shown in the illustration. The infected tissues were quite sharply marked off from the healthy part, both by their distortion and by their whitish color, being eventually covered by a mealy coating of spores, etc.

Cultures were made, and a fungus obtained that seems to be a conidial stage of this fungus, though its identity has not been thoroughly established.

The question whether or not the various forms of *Exobasidium* found on the different genera of the heaths are distinct or not has not been definitely decided. Often their macroscopic appearance on different hosts is quite distinct, but as Richards (Bot. Gaz. 21: 101. 1896) succeeded in producing the ordinary leaf form from spores of the unusual large bladder form on a different host, it looks to the writer as if these differences were largely due to the age or parts of the host infected. Shirai has described two species of *Exobasidium* on *Rhododendron indicum*, to one of which our fungus possibly may belong if they are really distinct, though the spore measurements do not seem to agree entirely.

CELERIAC, *Apium graveolens* var. *rapaceum*.

Leaf Blight, *Cercospora Apii* Fr. We have reported before, on celeriac, the leaf spot due to Septoria, but not this fungus. Both produce brownish or grayish spots of considerable size on the leaves, often causing them to turn yellow and die prematurely. They are often found associated, the Cercospora being distinguished by its minute threads arising from the surface of the leaves, while the Septoria forms small, embedded, black specks.

CHESTNUT, *Castanea* sps.

Chestnut Bark Disease, *Diaporthe parasitica* Murr. Specimens of this serious disease of our native chestnuts have been collected on the Japanese chestnut, *Castanea japonica*, in a local nursery. Dr. R. T. Morris, who grows a large number of varieties of chestnuts on his Stamford farm, also reports (Conn. Farmer, March 11, 1911, p. 2) that, besides the Japanese species, the European species, *Castanea sativa*, and the American Chinquapin, *Castanea pumila*, have been more or less subject to this blight at this place. See page 716 of this Report.

CHESTNUT, *Castanea dentata*.

Powdery Mildew, *Microsphæra Alni* (Wallr.) Wint. We have not reported this host because we have found the mildew on it previously only in the woods, but in September, 1907, it was observed on cultivated trees in a small nursery at Storrs. It forms evident, mealy, whitish growths, in which the perithecia

are embedded as small black specks, chiefly on the upper surface of the leaves. It is not an important disease of this host.

CHIVES, *Allium Schœnoprasum.*

RUST, *Puccinia Porri* (Sow.) Wint. This rust was collected by Dr. Britton during June, 1910, on chives in his garden in Westville, where it was doing considerable injury to the plants. Both the II and III stages were present, the former showing as minute, reddish, dusty pustules, and the latter as black, granular ones, more permanently covered by the epidermis. The leaves, when fairly abundantly infected, turned yellow and died prematurely. I have not seen any account of injury by this rust to cultivated species of *Allium* in this country, though in Europe it is not uncommon. Worthington Smith, in his Diseases of Field and Garden, page 39, mentions it, under the name *Puccinia mixta* Fckl., as causing serious injury to a crop of chives in England. There is more or less difficulty in deciding the proper genus of this fungus, since the telial spores in some specimens on certain hosts are almost or entirely single-celled, and so properly come under the genus Uromyces; other specimens show these spores largely two-celled, and so place it more properly under the genus Puccinia. Our specimens run more nearly to the former type, as not over one or two per cent. of the spores are two-celled. Winter considered the two as a single species, and we have followed him. Other writers place the single-celled form under *Uromyces ambiguus* (DC.) Fckl., and the form with most of its spores two-celled under *Puccinia Porri,* as given here. The rust on chives in Europe is generally reported under this latter name. Our specimens, however, have fewer two-celled spores than those we have seen from Europe on the same host. *Puccinia Allii* (DC.) Rud., also on species of *Allium,* is quite a different fungus.

CORNFLOWER, *Centaurea Cyanus.*

RUST, *Puccinia Cyani* (Schl.) Pass. Both the II and III stages of this rust were found, causing severe injury to the cornflowers in the writer's garden during the summer of 1909. The sori, while numerous, form rather inconspicuous, dusty outbreaks on both surfaces of the leaves and on the stems

Apparently this fungus has rarely been reported in this country. Another rust, *P. Centaureæ* DC., also occurs on other species of Centaurea both here and in Europe. Both of these species have frequently been grouped with other Puccinias, the species here reported being usually placed under *P. suaveolens,* along with the rust on *Cnicus* now commonly known by that name.

ELM, *Ulmus* sp.

Anthracnose, *Septoglœum Ulmi* (Fr.) Br. and Cav. This fungus was found on an escaped seedling of *Ulmus campestris* (apparently) along the roadside in Centerville. It produces numerous, minute, at first yellowish but finally reddish-brown spots on the upper surface of the leaves, while below the fruiting stage shows as minute, glistening, yellowish globules.

The fungus has usually been reported as *Phleospora Ulmi* (Fr.) Wallr., but the writer agrees with Briosi and Cavara that it belongs more properly under the above genus. *Cylindrosporium ulmicolum* Ell. and Ev. possibly is not distinct from this species, as its description is very similar. This *Septoglœum* is thought by some writers to be the spermagonial and *Piggotia astroidea* B. and Br., the pycnidial stage of *Dothidella Ulmi* (Duv.) Wint. [*Phyllachora Ulmi* (Duv.) Fckl.], though neither of these two stages were found associated with our specimens. The asco stage of *Dothidella Ulmi,* while not uncommon in Europe, does not seem to have been reported in this country except the doubtful specimen sent by Torrey to Schweinitz.

GOOSEBERRY, *Ribes* sp.

Rust, *Æcidium Grossulariæ* (Pers.) Schum. This rust was found on the leaves of a species of gooseberry, apparently escaped from cultivation, in the woods of an abandoned farm belonging to the water company at Ansonia. The fungus forms rather small clusters of cup-shaped fruiting bodies on the under surface of the leaves, producing discolored spots above. It is probably connected with some species of *Puccinia* on *Carex* as its mature stage, as has been found to be the case with several European forms on *Ribes* sp. We have never seen this *Æcidium* causing much harm to its hosts, and it seems to occur chiefly on the wild species.

HORSECHESTNUT, *Æsculus* sps.

Powdery Mildew, *Uncinula flexuosa* Pk. This mildew was found on a species of *Æsculus* with colored blossoms, on an estate at Chapinville in the fall of 1909. The conidial stage formed a conspicuous whitish coating on the upper surface of the leaves, while the perithecia were less prominent, though abundant, on the lower surface. The fungus has not been reported by us before, though Thaxter collected it in New Haven in 1888 on another cultivated species, *Æsculus Hippocastanum*.

MONKSHOOD, *Aconitum Fischeri.*

Stem Rot, ? *Hypochnus* sp. In our Report for 1907, page 351, we described this stem rot, which was found on a variety of herbaceous plants in a local nursery. This year it was sent to us from Westbrook, where it was injuring specimens of larkspur, one of the hosts reported before. Since our first report we have also found it on monkshood, in the same nursery where it was found originally. So far we have been unable to identify the fungus, as our cultures form only the sclerotial stage—small, reddish, usually subspherical bodies about 2 to 5 mm. in diameter. We have a similar fungus from potato stems, forming considerable small sclerotia, that was given to us by Morse of the Maine Station. While in Japan, we saw in Professor Hori's laboratory artificial cultures of a number of these sclerotial fungi, which he had described as species of *Hypochnus,* though we are not sure of this identification from what we have learned concerning them.

PINE, *Pinus* sps.

Pine-Oak Rust, *Cronartium Quercus* (Brond.) Schrœt. (I. *Peridermium cerebrum* Pk.) On specimens of jack pine, *Pinus Banksiana,* in the nursery of the station forest plantation at Rainbow in the spring of 1910, Mr. Filley, and later the writer, collected the I stage of this fungus. These seedlings were about four years old, and had been brought in 1908 from Michigan, where no doubt they were originally infected, as this fungus in none of its stages has ever before been found in this state. The fungus on the pine forms conspicuous

swellings, usually globular in shape, and in early spring the fruiting stage shows under the denuding bark as orange-colored, dusty spore masses, with the peridia rarely forming distinct cups, as in the next species. The II and III stages occur on species of oak. So far as could be seen, these did not appear on the oaks in the vicinity, and as all the infected pines were destroyed, it is not likely to become established there. Infection experiments made in the laboratory from the I stage, however, produced the III stage only very readily on seedlings of both red and white oaks. So far this fungus has not done much damage elsewhere on either host. See Plate XXXVI b.

PINE-SWEETFERN RUST, *Cronartium Comptoniæ* Arth. (I. *Peridermium pyriforme* Pk.) In the Report of 1907, page 380, the writer reported the I stage of this rust on both *Pinus rigida* and *P. sylvestris* from this state. It had become established on the latter host in the station forest plantation at Rainbow. In 1910 it was found there also on *Pinus rigida, P. austriaca,* and *P. maritima.* It was also found in its II and III stages on the sweetfern, to which it had spread since its introduction. Apparently most of these pines had become infected in their nursery beds at Poquonock before transplanting here some years ago, as thousands of seedlings of *Pinus rigida* grown from the first in their vicinity showed practically no infection. The specimens of *P. maritima,* however, had become infected there in their seed bed, yet we could find no infected sweetfern in their immediate vicinity this year. In order to prevent further spread of the rust, all infected pines were destroyed or the infected branches cut off, and the forester had all the sweetfern in the vicinity mowed off. Most of the pines, having the fungus on their main trunk, were of little value. Where infection takes place after the pines are a few years old, the damage is not likely to be nearly so severe as when it takes place in the seed bed. See Plate XXXVI c.

PINE, WHITE, *Pinus Strobus.*

Drought Injury. In the fall of 1909, Mr. Spring noticed a few spots in one of the seed beds at the station forest plantation where the white pine had been entirely killed out for the space of a few inches. Specimens of these and some of the adjacent living pines were brought to the writer at the time for examina-

tion. On the stems of the dead pines, and also somewhat on the living ones, was a conspicuous felt of mycelium of a hymenomycetous fungus which Professor E. A. Burt determined as *Coniophora byssoidea* (Pers.) Fr. At first we thought that this fungus was responsible for the death of the seedlings, but we were unable to find any account of injury caused by it elsewhere. A bunch of these young pines was kept in a crock in the greenhouse for several months, and there was no indication that the fungus injured the healthy young pines on which it originally occurred, or that it spread further. The fungus evidently ran up on the stems merely as a saprophyte, from various leaves on the ground on which it also occurred. The pines in the seed beds were probably killed by the drought, which was so severe in 1909, and the dead and injured seedlings offered a better condition for the development of the fungus than the surrounding mulch of leaves, as Professor Burt states that out of nine specimens in his herbarium seven are on pine and two on spruce. See Plate XXXV a.

Frost Injury. Plate XXXV b. In examining the seed beds of white pines at the station plantation at Rainbow in the fall of 1910, the writer found small spots scattered in the beds where the leaves of this year's growth had been killed. The injury was evidently caused by the late frosts of May and June of that year, as these had killed the leaves of the scrub oaks in this vicinity, as observed at the time. The young pines had developed their terminal branches an inch or two in length, and these had been severely injured or killed by the frost on both the one- and two-year-old seedlings. The leaves of the previous year remained uninjured. Afterwards these injured pines put out several lateral buds from or below the injured tip, but even as late as November 1, when seen by the writer, these had not usually attained a length of half an inch. This injury had severely stunted the growth of the plants during the season, as is indicated by the photograph, which shows one of the uninjured plants, besides several of the injured ones of the same age. A few seedlings of *Pinus montana* were also injured, but not so extensively as were those of the white pine.

Pine-Currant Rust, *Cronartium ribicola* Waldh. (I. *Peridermium Strobi* Kleb.) Plate XXXVI a. In our article on Heterœcious Rusts of Connecticut, published in the Report for 1907,

page 374, we mentioned this rust as one likely to be brought into this state on imported white pine seedlings from Europe. Its introduction really occurred sooner than was anticipated. Mr. F. A. Metzger first found specimens on a lot of three-year-old seedlings from Germany that had been imported by our State Forester for Mr. C. F. Street, and planted at Wilton. Mr. Metzger, who was employed to set them out, found in the 10,000 seedlings from fifty to one hundred that were infected with the rust. He brought specimens to the station the last of April, 1909, but as the writer was in Japan at that time, nothing further was done.

In the meantime Messrs. Metcalf and Spaulding, of the U. S. Department of Agriculture, who had been looking up infected seedlings in other states, came to this state about the middle of June, and with the forester examined the plantations of the New Haven Water Company at West Haven and the Ansonia Water Company near Ansonia, and found a few very suspicious specimens at these places. Arrangements were made soon afterward by which Mr. Spaulding and Mr. Graves for the Government and the botanical department for the station undertook during July to go over the plantations in the state where white pine seedlings had been imported from Europe, and inspect them for this rust, and to destroy any infected seedlings, if found, and any wild gooseberries or currants in their vicinity, as the II and III stages occur on the latter as alternate hosts. It was really then too late in the season to find the fungus on the pines, except far past its prime. However, twenty-four plantations, including about 580,000 seedlings, were inspected, and very suspicious or positively identified infected specimens were found at two additional places; viz., at the Plant estate plantation at East Lyme and at the Groton Water Company plantation at Poquonock. In none of the five places where signs of the pine rust were found were more than a dozen specimens seen, except at the Street plantation, where the diseased plants were noticed as they were being set out. A descriptive letter concerning the rust and its reputation was sent to all those who had used imported seedlings.

In 1910 the botanical and forestry departments of the station undertook to again go over these and other plantations, beginning early in the season, as soon as the rust ordinarily makes its

appearance. During May and June four inspectors visited twenty-six plantations, inspecting about 425,000 seedlings, and made very careful examinations for the rust, in many cases examining every individual seedling. In spite of this thorough examination, not a single rusted plant was found! No doubt the severe drought of the preceding year had killed off those seedlings weakened by the rust, if such existed. Of course it is possible that examination another year might reveal a few rusted plants, as it is usual for the seedlings to go one or possibly more years after infection, before the æcial stage of the rust appears on them.

During the years 1907, 1908 and 1909, there were imported into the state, chiefly from Germany, under the supervision of the station's forestry department, about 640,000 white pine seedlings, which were set out in fifty-five different localities, and private individuals have imported at least 100,000 more. All of these seedlings, except about 95,000 set out mostly in small lots in twenty different localities, have now been inspected once or twice for the rust. No doubt, too, at the time they were set out the men would have discarded any specimens showing evidence of the rust. In all of the plantations examined, watch was kept for any signs of currants or gooseberries in the vicinity of the pines, and these were destroyed when found. Fortunately, species of *Ribes* in a wild or escaped state are comparatively rare here, so that even if this rust occurred on the pines, it would be much more difficult for it to pass to these hosts than in some of the more northern states where they are more frequent. In 1910 the station did not import any white pines because of the danger of bringing in this rust, and only one lot, to our knowledge, was imported by others. Examination of these showed no signs of the rust. From now on it is probable that most of the seedlings set out will be native grown stock, as plenty of this seems to be in evidence at fair prices. There does not seem to be much likelihood, therefore, that the rust will obtain a foothold in the state, though watch will still be kept for it. Anyone finding suspicious specimens should send them to the station for examination.

Infected white pine seedlings, out of the season when the fruiting stage appears, may be recognized in a general way

by the somewhat fusiform swollen stems and by the bunching of the leaves, shown by the halftones in Plate XXXVI a. Not all swellings of the stem, however, are due to rust, as insect and other injuries may produce such distortions in young seedlings. During the months of May and June the fruiting stage shows on the swollen stems as small, white, oblong blisters that upon rupture reveal an orange mass of spores. These gradually wear away, and then positive evidence of infection is more or less difficult. The mycelium remains in the infected tissues, gradually spreading to the new growth, and renews its fruiting stage each spring, unless the death of the host intervenes. The spores produced on the pine do not spread the disease to other pines, but develop two other spore stages on both gooseberries and currants, the last stage carrying the fungus back to the pines.

Many writers consider this rust as a very serious menace to white pines. The writer is not so much afraid of it in this state because of the scarcity of the alternative hosts, and also because it looks to him as if most of the damage comes from the use of infected seedlings, which we should be able to largely eliminate here. Such infection as might occur after the pines once got a good start in the forests we are inclined to believe would be rare, and not nearly so injurious to the host. We have heard of one large importer of white pines who intends also to import a large number of currant bushes for commercial purposes. Such a condition offers a chance for the rust to do considerable harm if it once gets started in either of his plantations.

The native pine-sweetfern rust, which we describe elsewhere, seems to us to be just as virulent as this rust, and one much more likely to spread generally here, on account of the frequency of its alternate host, the sweetfern. Yet, with the exception of the plantation at Rainbow, where pines were infected in the seed beds, we have seen and heard of no damage by this rust. This rust does not occur on the white pine, though it has several other species for its hosts.

PRIVET, *Ligustrum vulgare.*

ANTHRACNOSE, *Glœosporium cingulatum* Atk. Mr. Coe, of the Elm City Nursery Company, first called the writer's attention

to this disease on a variety of privet called *italicum*, which was imported from France in the spring previous to our examination in the fall of 1910. The fungus causes diseased areas on the stem and branches, which are not very conspicuous, being slightly sunken and a different color, but when these cankers entirely girdle the branches, the leaves and finally the whole branch above die, and the trouble becomes very evident. The injury at this place was quite noticeable, through the dead branches and one or two dead bushes, but probably the shock of transplanting may have weakened the plants so that the trouble was more conspicuous than it would be under more favorable conditions for the host.

When Atkinson originally described this fungus (Bull. 49, Cornell Exp. Sta.) in 1892, he said nothing about the injury to the host, and we have seen no reference where it is said to have caused conspicuous injury, though it seems to be capable of it. Atkinson obtained cultures of the fungus, described the conidial stage, and suggested that it had a mature stage, which his student, Miss Stoneman, later described (Bot. Gaz. **26**: 101. 1898) as belonging to the genus *Gnomoniopsis*, now known as *Glomerella*.

Cultures of the fungus were easily obtained by the writer from the cankers, and these produced both the conidial and the asco stages. Miss Stoneman notes the presence in the cultures of setæ connected with the conidial stage, but did not find these on the host. The writer, however, found some of these setæ with the conidial stage on the host.

RASPBERRY, *Rubus strigosus*.

RUST, *Puccinastrum arcticum* var. *americanum* Farl. This rust, which was described a few years ago by Professor Farlow (Rhodora **10**: 13. 1908), has ordinarily been confused with the uredo stage of *Kueneola albida*, as, like that species, it forms very small orange outbreaks on the under side of the leaves. Microscopically, however, the two are quite distinct. The uredo stage was sent to the writer from Stamford in September, 1909, on cultivated raspberry, this being the first time it has been found in the state. It apparently did little harm to its host. The æcial stage is unknown, though it may be ***Peridermium balsameum*** on the balsam fir.

RYE, *Secale cereale.*

Powdery Mildew, *Erysiphe graminis* DC. In our Report for 1903 we listed the conidial stage of this mildew on cultivated barley. In 1910 specimens on rye were received from J. F. Shepard, of New Haven, and others were collected by the writer at the station farm at Centerville, these being the first collections on this host in the state. In the latter locality the perithecial stage was very conspicuous and abundant on rye, but on barley was practically absent. Considerable injury was caused to both these hosts through severe infection of the leaves, which died prematurely. Apparently the season was favorable for an unusual development of the fungus. It forms an evident grayish felt in small clusters, thickly covering the leaves, and the perithecia, when produced, show as small but evident black specks embedded in this. As usual with this species, none of the asci matured their spores on the living plants.

SQUASH, *Cucurbita Pepo.*

Chlorosis. In previous Reports we have mentioned chlorosis troubles of Lima and string beans, muskmelon, tobacco and tomato. Of these so far we have been able to prove only those of tobacco and tomato to be infectious, that is, capable of producing the trouble in healthy plants when juice from the chlorosis plants is placed on the young leaves. In June, 1910, we saw plants of summer squash in cold frames at the Farnham farm in Westville that were subject to a chlorosis trouble, though from its appearance it did not impress us as being of an infectious nature. The leaves were quite prominently streaked with irregular areas of lighter yellowish-green, the normal green color remaining more commonly around the veins. The cause of the trouble was not determined, though possibly too much manure in the beds may have had something to do with it.

SWEET PEA, *Lathyrus odoratus.*

Powdery Mildew, *Erysiphe Polygoni* DC. Previous to this we have reported in this state only one trouble of the sweet pea; viz., a rot disease. This powdery mildew forms a mealy, whitish growth on the leaves through the production of its conidial stage, but the perithecial stage was not found. Apparently the

mildew is not a conspicuous parasite of the sweet pea, as it is not listed on this host in the more prominent works on the mildews. The absence of the mature stage renders its determination somewhat doubtful, but as the conidial stage agrees with the above species, and as this has been reported on several other species of *Lathyrus*, it is more likely to be this than any other species.

WALNUT, ENGLISH, *Juglans regia.*

WHITE MOLD, *Microstroma Juglandis* (Ber.) Sacc. We have reported this fungus before on cultivated specimens of our native butternut. It was sent to the writer in July, 1909, by Dr. R. T. Morris on the variety *Kaghazi* of the English walnut, grown on his farm at Stamford. While this fungus forms conspicuous white patches on the under sides of the leaves, it is not usually a very serious pest.

WHEAT, *Triticum vulgare.*

STINKING SMUT, *Tilletia fœtens* (B. and C.) Trel. Very little wheat is grown in this state at the present time, so that this smut has not been collected here in the fields. However, it is of economic importance in another way. At least four times during the last few years samples of commercial wheat feeds, usually in the shape of middlings, have been sent to the station for examination because animals refused to eat the feed. Two of these samples have come from feed men and two from farmers. A microscopical examination in each case has shown the presence of the spores of the stinking smut. In a sample recently received from Mr. R. A. Jones of Bethlehem, the smut spores were unusually abundant. Mr. Jones said that the middlings had been fed to hogs, that it made them sick, and that some of them refused to eat more. After changing to other food the hogs got over their trouble.

Feeds that contain these spores indicate not only that they are made from middlings, but from badly smutted or injured wheat, which would be of no value for flour. Whether or not the smut spores are themselves the injurious principle might be questioned, but there seems to be no question, if they are not, that the action of this fungus, or its opening the way for

bacteria to act, produces in the plant tissues deleterious products that injure or render dangerous their use for feeding purposes.

Tubeuf, in the English edition of his Diseases of Plants, page 306, says concerning *Tilletia Tritici* (a very closely related smut, also found in grain in this country): "The smut also possesses poisonous properties which make flour contaminated with it dangerous to human beings and the straw or chaff injurious to cattle. . . . The symptoms in the few cases of disease observed do not agree very closely. A paralyzing effect on the centers of deglutition and the spinal cord seem to be regularly present. As a result one generally finds a continuous chewing movement of the jaws and a flow of saliva, also lameness, staggering, and falling. Cattle, sheep, swine and horses are all liable to attack."

McAlpine, in his Smuts of Australia, page 81, records a case in which six hundred and fifty Leghorns dropped in a few days from a daily average of one hundred eggs to sixteen when they were fed on smutted wheat, and when this was stopped and clean wheat substituted, they regained in three weeks an average daily yield of eighty eggs. He also records an experiment with pigeons in which one pair was fed smutted wheat for twenty-two weeks, while the other pair was fed sound wheat. The doves fed good wheat laid seven eggs during this period, while the others laid only two. Both pairs of pigeons at the start were in good plumage, and the pair fed on good wheat retained the good plumage and was fat at the end of the experiment, while the other pair was in poor condition, with the feathers all standing out.

While writing on this subject of deleterious animal foods, we might mention that we have also occasionally had whole oats sent in that horses refused to eat. We have never found any fungus that might be the cause of a musty condition of these oats. It has been thought that in these cases the oats were bleached by some sulphur process, and that this had left them unpalatable to the horses. We have also recently heard of a case where certain farmers last year purchased oats for feeding purposes, and as they looked plump and *white* they were also used for seed. None of the fields sowed with these oats came up, and as they were to serve as a cover crop for grass seed, the latter also failed. It seems quite probable that

these oats had been sulphured, and their vitality entirely destroyed. Seed at all suspicious should be sent to the station to have its germination tested.

We have also had one or two cases called to our attention recently where animals have been made sick and some have died from eating silage. In such cases the silage had not been properly made and had become moldy, and the fungous growths no doubt had produced poisonous products in the decomposition of the silage. Similar troubles have been noticed elsewhere from feeding moldy silage (see Pammel's Manual of Poisonous

II. SPRAYING POTATOES IN DRY SEASONS.

General Considerations.

Object. In our Report for 1904, page 363, we gave the results of spraying potatoes during the three wet years, 1902 to 1904, when blight was unusually severe in this state. The sprayed parts of these fields showed increased yields, varying from 18 up to 108 per cent., according to the season, thoroughness of the spraying, etc. During these experiments certain points came up for consideration upon which we had no data to base conclusions. For example: (1) Would manure tend to increase the amount of rot in a field badly blighted over the amount of rot in the same field in which a commercial fertilizer was used? (2) Would the use of the same land for two or three years in succession tend to increase the amount of rot in the successive crops, other things being the same; and would blight tend to appear earlier in such a field? (3) Would ridging the rows help to prevent the blight spores from being washed down to the tubers, and so decrease the per cent. of rot as compared with level culture under the same conditions?

In order to answer the above questions, the writer started a series of experiments in 1906, which were carried on for the four years ending in 1909. Unfortunately for the primary objects of the experiments, these years proved to be ones in which blight did very little harm in this state. In fact, in three of these years we were unable to find any of the blight fungus on potatoes in this experimental field, and in the other year it was so scarce as to cause practically no harm. However, while the main objects of the experiments remained unanswered, we still obtained data regarding spraying in dry seasons, also some data regarding scab, which we present in this paper.

Conditions of Experimentation. The experiments were carried on each year on the same plot of ground; viz., two-thirds of an acre of level, uniform, light loam, with a very leachy subsoil, at the station's temporary experimental farm leased of Mr. Webb at Centerville. This land had not been cultivated or fertilized for some years before our experiments began, and so was in very poor shape for growing crops of any kind. Amount of yield, however, except in a comparative way, was not contemplated in these experiments.

The land was divided into plots as follows: The east each year was fertilized with manure at the rate of sixtee eighteen tons per acre, while the west half received about equivalent of the nitrogen in the manure in the shape of two plications of nitrate of soda (rate of 450 lbs. per acre). Each received the same amount of muriate of potash (rate of 300 the first and second years, and 450 lbs. the other two years, acre) and bone meal (rate of 200 lbs. per acre each ye As the manure had also some phosphorus and potash in it, naturally gave that half of the field a somewhat better fe zation than the half on which sodium nitrate was used, an a matter of fact it showed this each year in a more luxur growth and a larger yield.

Running crosswise of the manured and sodium nitrate hal the field was divided into halves, one of which received l culture and the other modified ridge culture. This ridged was really cultivated the same as the level until the first to middle of July, when, during the last two cultivations, potatoes were ridged by the shovel cultivators as much possible, and in some seasons hilled further with a hoe. order to bring the tubers in the level culture near the gro and those in the ridged culture as deep as possible, the for were planted only three or four inches deep, while the la were planted five to seven inches. Ordinary cultivation, averaging once a week, was given the whole field. Some h work with the hoe was also given. Each year the halves gi level and ridged culture were reversed, so that any inequa of land might be cancelled.

The central halves of the ridged and level cultivated r were sprayed with Bordeaux mixture (4-4-50 formula), lea similar unsprayed rows on either side. Usually about th sprayings with Bordeaux were given, and as these were m by hand, they were very thorough. The first spraying generally given about the middle of July, and the last ab the first of September. All the potatoes were sprayed for inse either with Paris green or with arsenate of lead, so as to m conditions the same so far as insect injury was concerned.

These treatments divided the field into eight equal areas, e receiving some different point of treatment, as follows: sprayed, manured, ridged; (2) unsprayed, manured, ridg

(3) sprayed, sodium nitrate, ridged; (4) unsprayed, sodium nitrate, ridged; (5) sprayed, manured, level; (6) unsprayed, manured, level; (7) sprayed, sodium nitrate, level; (8) unsprayed, sodium nitrate, level.

The potatoes were dug in October, after all the vines were dead, and comparative yields determined by taking the counts and weights from fifty-foot lengths in two separate rows of each plot for comparison, but the figures given in the tables are for the combined one hundred feet. To avoid any unevenness due to the difference in the land, the sprayed and unsprayed rows, which otherwise received the same treatment, were always taken as near together as possible.

Results. Sprayed versus Unsprayed. In the four years, out of the forty-four comparisons of fifty feet of sprayed vines with the corresponding unsprayed vines, the sprayed lots in every case except three gave a greater yield. In these three exceptions the average of the two tests of fifty feet of sprayed vines in each case was greater than the corresponding average of the two fifty feet of unsprayed vines, so that it can be stated that during the four years' tests the sprayed lots invariably gave a higher yield than the unsprayed. Table 1 gives the averages for the four years of these sprayed and unsprayed potatoes, and from this we find that the average increase of all the sprayed vines over unsprayed vines was about 32 per cent. The increased yield of the sprayed over the unsprayed by years was as follows: In 1906, 30 per cent.; in 1907, 24 per cent.; in 1908, 17 per cent.; in 1909, 53 per cent. Plate XXXVII b shows the comparative yields in 1906 on the sodium nitrate half (1) sprayed, ridged; (2) unsprayed, ridged; (3) sprayed, level; (4) unsprayed, level. As shown in our previous experiments, the increased yield of the potatoes was not only due to increased numbers of marketable tubers, but also to increased weight of the tubers, especially the larger ones.

In every one of these years, the spraying, theoretically, more than paid for itself, despite the fact that none were blight years. Stewart, in the 1906 Report of the Geneva, N. Y., Experiment Station, shows that out of fourteen coöperative experiments with farmers in different parts of the state in 1905, it cost from $2.44 to $6.84 per acre to make the sprayings, or an average cost for all of $4.25 per acre. We think that in this state, to be on the safe side, we may estimate the cost, including bother, of spraying

at $10.00 per acre. It often requires more time to cart water and make up the mixture than it does to apply it. If the spraying is done by hand, it also costs more than when done with spraying machines, but a more thorough job can be done in this way with three sprayings than with five by any power sprayer we have seen. Taking the cost of spraying then, at $10.00 per acre, and the average yield of an unsprayed field in this state at the conservative figure of 130 bushels per acre, we find that the lowest increase in yield due to spraying, namely, 17 per cent., means 22 bushels, and the highest increase, 53 per cent., means 69 bushels. At the very low price of fifty cents per bushel, the lowest increase would mean $11.00, or one dollar net profit, and the highest, $34.50, or $24.50 profit. We have made these estimates especially conservative by taking comparatively low yields and a high cost of spraying per acre. Years when blight really did harm in the fields would of course make the gains very considerably greater, if the spraying were well done.

The question naturally comes up, why did the sprayed potatoes give this increased yield over the unsprayed if there was no particular injury caused by the late blight fungus? Some little benefit was no doubt derived from the prevention of the early blight, but this must have been scarcely appreciable because this fungus was not at all conspicuous these years. Again, some very small benefit may have been due to lessening insect attack, since potatoes sprayed with both Bordeaux and Paris green keep off the insects somewhat better than where sprayed only with Paris green. This is especially true as regards the potato flea beetle. But here again the gain was of a very minor kind. Ordinarily botanists have explained this increase as due to some stimulative effect the Bordeaux mixture has on the chlorophyll of the potato leaves in increasing starch production. Personally, the writer believes that the results are largely due to *conservation of moisture in the leaves in dry seasons by clogging up the stomata and water pores with the sediment of the spray*. The reasons for this belief are (1) that the potato leaves, through their numerous stomata and terminal water pores, lose water very easily, and are especially susceptible to what is known as tip burn in dry seasons; (2) that the unsprayed vines uniformly suffered earlier and more severely from tip burn than the sprayed, which were green for about two weeks after the unsprayed were dead; (3) that in

1910, which was a season like the preceding years, except with a little injury from blight at the very end of the season, spraying with "Sulphocide" and commercial lime-sulphur, sprays with comparatively little sediment, did not prolong the life of the vines or give increased yield, while spraying with Bordeaux mixture did.

*Results: Ridged versus Level Culture.** As to the primary object of these two methods of culture, we have very little data, since there was practically no rot in the potatoes during the four years. We hope to continue the experiment until seasons favorable for rot shall give us data on this subject. That there is some basis for the belief that ridging will be of help in lessening the rot was shown in our experiments in 1910 in another field, where the ridged rows, both sprayed and unsprayed, gave practically no rot against a small per cent. in the level rows. This was especially true of the unsprayed level rows, which gave about nine per cent. of tubers rotted against only one-half per cent. in the sprayed level rows, though the blight appeared on the foliage only in a small way toward the end of the season.

While our data are not very enlightening on this point, still the experiments do show results along a related line, namely, that the ridging did not materially lessen the yield. There are those in this state who advocate level culture because of the supposed increased yield over ridging, and if this is so, then any increased yield due to prevention of rot in the ridged potatoes might be more than outbalanced by the increased yield due to level culture, especially taking the yields year after year, many of which show no rot. However, with our modified ridged culture (as explained previously) we do not find in averaging the four years that the ridged potatoes gave any very materially smaller crop than the level, since the average of the latter was only about 6 per cent. higher than the former, and to offset this, the 1910 crop in a different field slightly favored the ridged. Taking the yields by years, the level culture gave slightly better crops in 1906, 1907, and 1908, and the ridged in 1909 and 1910. As these last four years were chiefly drought years, the test was even more severe than it would be in wet seasons. Likewise, the data that we obtained in some coöperative experiments with farmers in 1906 did not seem to show that the ridged potatoes were at a disadvantage, judging from the yields given and the general opinion of the growers where no measurements were taken.

In connection with the spraying, it may be noted that the *average* for the four years gave a slightly greater proportional increase in the sprayed ridged over the unsprayed ridged than was given by the sprayed level over the unsprayed level, on both the manured and the sodium nitrate plots, though in two of these years (1907 and 1909) the proportional increase was greater for the level. This perhaps may be explained by the unsprayed ridged potatoes suffering on the whole slightly more from the droughts.

Results: Manure versus Sodium Nitrate. Here again we did not get any data relative to whether or not manure increased the amount of rot in fields in blight seasons. From our correspondence with farmers, they seemed to favor the opinion that manured fields rot worse than those where chemical fertilizers only are used. While we did not get data on the blight, we did obtain data regarding scab and the use of manure, which we will mention later.

Of course the manured half of the field each year gave a greater yield than the sodium nitrate half, since it was better fertilized. The average increase for the four years of the manured over the sodium nitrate was about 47 per cent. There is no doubt that manure is a very good fertilizer for potatoes, but at the same time there is greater danger of injury from scab and apparently from rot with its use. The most sensible way to use manure seems to be either in a heavy application on corn the previous year, using only a commercial fertilizer the same year with the potatoes, or at least to put it on the land and plow it in the preceding fall rather than in the spring just before planting the potatoes, as was done in our experiments. As regards spraying, the sodium nitrate sprayed rows uniformly gave a higher per cent. of increase over the checks, either ridged or level, than did the sprayed manure rows over the unsprayed checks. We are not sure of the reason for this, unless it was because the manured rows suffered earlier and more severely from the drought. Our manured plot also had more weeds than the sodium nitrate plot.

Results: Scab. These experiments showed very strikingly how the continued use of the same land for potatoes greatly increases the amount of scab. Even if it were of no benefit in the prevention of rot, rotation certainly is of value in lessening scab. The first year the potatoes were on the land the per cent. of scab was so

small that it was not determined. It certainly was below 5 per cent., and probably not over 1 per cent. The second year, 1907, the scabby tubers had increased to 22 per cent., in 1908 to 47 per cent. (the same potatoes in our general rotation fields this year gave only about 1 per cent. scabby), and in 1909 to 63 per cent. The last two years the scab was so bad as to seriously affect the market value of the potatoes. The scab on the manured half was more serious than on the sodium nitrate half, since the average scab for the three years 1907 to 1909 for the former was 48 per cent., while on the latter it was only 33 per cent. As regards level and ridged rows, there was more scab in 1907 and

TABLE I.—SPRAYING EXPERIMENTS—AVERAGE, 1906, 1907, 1908 AND 190

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very sm	W
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt	No.	
(1) Sprayed, Manured, Ridged	2	2	77	25	161	25	240	52	82	
(2) Unsprayed, Manured, Ridged	0	0	61	19	141	21	202	39	74	
(3) Sprayed, Sod. Nitrate, Ridged	3	2½	64	20	102	14	170	36	40	
(4) Unsprayed, Sod. Nitrate, Ridged	0	0	50	14	90	12	140	25	45	
(5) Sprayed, Manured, Level	2	1¼	78	25	183	27	264	54	119	
(6) Unsprayed, Manured, Level	1	1	68	18	168	22	236	43	151	
(7) Sprayed, Sod. Nitrate, Level	0	0	66	20	131	17	197	38	74	
(8) Unsprayed, Sod. Nitrate, Level	0	0	45	13	116	15	162	28	80	
Average—Sprayed	1	1	71	23	141	21	217	45	77	
Average—Unsprayed	0	0	56	16	68	17	185	34	87	

1909 in the ridged rows and less in 1908, and in the average for the three years the ridged ran slightly higher, though whether this means anything or not we do not know. As the level and ridged halves were alternated each year, this shows that it was the same side of the land that each time gave the most scab, and so the nature of the land rather than the manner of cultivation may have been the determining factor. It is certain, however, that the level rows suffered much more from sun scald.

Details of Experiments in 1906.

Treatment. May 2: Planted with Carmen No. 3. *June 21:* Sprayed all with Paris green. *July 6:* Gave second spraying with Paris green. *July 16:* Gave first spraying with Bordeaux mixture (4-4-50) by hand. Used Paris green in Bordeaux, and gave un-

sprayed half the third treatment with Paris green, as bugs were unusually bad. Also gave first ridging to ridged half about this time. *July 24:* Gave final ridging. *July 27:* Made second treatment with Bordeaux. *August 8:* No blight, but a little early blight and considerable tip burn, especially on unsprayed vines. *August 11:* Gave third spraying with Bordeaux. Found a very few blight leaves on unsprayed vines. *August 26:* Difference between sprayed and unsprayed vines quite marked in favor of former, due to tip burn and insect injury. *September 6:* Unsprayed vines fully two-thirds dead from tip burn, while on the sprayed not one-half the leaves were dead. Gave two rows only

TABLE II.—SPRAYING EXPERIMENTS IN 1906.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rc Nc
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	
) Sprayed (3), Manured, Ridged	5	3¾	154	43	159	18½	318	65¼	28	¼	[illegible]
) Unsprayed, Manured, Ridged	0	0	125	32¼	140	14¼	265	46½	22	¼	[illegible]
) Sprayed (4), Sod. Nitrate, Ridged	2	1½	167	45¾	106	12¼	273	59½	15	⅕	[illegible]
) Sprayed (3), Sod. Nitrate, Ridged	5	3½	122	32¾	134	14¾	261	51	16	⅕	[illegible]
) Unsprayed, Sod. Nitrate, Ridged	0	0	103	25	109	10½	212	35½	22	¼	[illegible]
) Sprayed (3), Manured, Level	8	5	171	51	166	19½	345	75½	35	⅓	[illegible]
) Unsprayed, Manured, Level	3	2½	140	27½	201	20¾	344	60¾	29	⅓	[illegible]
) Sprayed (4), Sod. Nitrate, Level	2	1½	159	41	158	16½	318	59	24	¼	[illegible]
) Sprayed (3), Sod. Nitrate, Level	0	0	146	42¼	143	16½	289	58¾	21	¼	[illegible]
o) Unsprayed, Sod. Nitrate, Level	0	0	102	29¼	164	17¾	266	47	26	¼	[illegible]
verage—Sprayed (3)	3	3	148	42	150	17	303	61	25	¼	[illegible]
verage—Unsprayed	1	1	117	28	153	16	272	47	25	¼	[illegible]

a fourth treatment, as vines were too far gone and blight was doing no particular harm.

Results: It is a question whether the fourth treatment did much good, though in the ridged rows it gave a better yield than the ridged row sprayed only three times. There was more rot this year than any other, yet not enough to do any harm. Besides the evident difference in the life of the vines, the yield also showed a corresponding difference in favor of the sprayed rows. The sprayed (3) manured ridged lot gave a 40 per cent. increased yield over the unsprayed manured ridged, as compared with 24 per cent. increase for the sprayed manured level over their unsprayed rows; the sprayed sodium nitrate ridged gave 43 per cent. increase over the unsprayed sodium nitrate ridged, while the sprayed sodium nitrate level gave 25 per cent. increase over the

unsprayed check rows. The average of all the sprayed rows over the unsprayed was about 30 per cent., or the second best results of the four years' test. The details of yields are given in Table II.

Details of Experiments in 1907.

Treatment. On *May 1* planted Green Mountain variety. *July 3:* Gave first application to all rows of insecticide, as bugs were late in starting this year. *July 8:* Gave first ridging to ridged half. *July 16:* Gave first spraying with Bordeaux, and used

TABLE III.—SPRAYING EXPERIMENTS IN 1907.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	S … C…
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
(1) Sprayed (3), Manured, Ridged	0	0	19	7	143	21½	162	28½	164	6¾	0	[illegible]
(2) Sprayed (2), Manured, Ridged	0	0	20	7½	140	21½	160	29	130	5½	0	[illegible]
(3) Unsprayed, Manured, Ridged	0	0	21	6¾	112	17	133	23¾	97	4¼	0	[illegible]
(4) Sprayed (3), Sod. Nitrate, Ridged	0	0	24	7	93	12½	117	19½	87	2¾	0	[illegible]
(5) Sprayed (2), Sod. Nitrate, Ridged	0	0	33	10	96	13½	129	23½	68	2¼	0	[illegible]
(6) Unsprayed, Sod. Nitrate, Ridged	0	0	19	5½	92	12½	111	18	91	4¼	0	[illegible]
(7) Sprayed (3), Manured, Level	0	0	13	4½	162	25½	175	30	162	6½	0	[illegible]
(8) Sprayed (2), Manured, Level	0	0	22	8½	155	25¼	177	33¾	130	5¾	0	[illegible]
(9) Unsprayed, Manured, Level	0	0	9	3¾	127	19¾	136	23½	262	10	0	[illegible]
(10) Sprayed (3), Sod. Nitrate, Level	0	0	28	8¾	117	14	145	22¾	122	3½	0	
(11) Sprayed (2), Sod. Nitrate, Level	0	0	10	3¾	118	18½	128	22¼	148	5½	0	
(12) Unsprayed, Sod. Nitrate, Level	0	0	7	2¼	102	15½	109	17¾	149	6¼	0	[illegible]
Average—Sprayed (3)	0	0	21	7	128	19	149	26	128	5	0	[illegible]
Average—Unsprayed	0	0	14	5	108	16	122	21	150	6	0	[illegible]

insecticide with it and alone on unsprayed vines. *July 19:* Gave final ridging and cultivation of potatoes. *August 5:* Made second spraying with Bordeaux. No signs of blight, but tip burn bad, especially on unsprayed potatoes, and showed more with those on manured rows than on sodium nitrate rows. *September 6:* Gave third spraying to six rows only (three ridged and three level), as it was rather late to do much good. No signs of blight this season. Unsprayed vines with level culture more uniformly dead than the unsprayed ridged. Sprayed rows still showing consider-

able percentage of green leaves, especially on sodium nitrate part, but difference not so marked as in previous year.

Results. On account of drought, the yield this year was considerably less than any of the other years. The third spraying was too late to do any good at all. If the first spraying had been made about the first of July and the third the last of August, the results would have been better. The sprayed (3) manured ridged rows gave an increase of 20 per cent. over the unsprayed manured ridged portion, while this was increased to 27 per cent. on the sprayed manured level over the corresponding unsprayed portion. The sprayed (3) sodium nitrate ridged rows gave only 8 per cent. increase (30 per cent. in the case of those sprayed twice) over the unsprayed, while the sprayed (3) sodium nitrate level gave 28 per cent. over the unsprayed portion. The average increase of all the sprayed over the unsprayed was 24 per cent. Table III shows details of yields.

Details of Experiments in 1908.

Treatment. On *April 29,* planted Green Mountain variety. *July 5 to 10:* Gave first ridging. Vines were sprayed twice with arsenate of lead for bugs, which were not bad this year. *July 17:* Gave first spraying with Bordeaux. This was rather late, as the tip burn was already evident, especially on manured half. *July 27:* Gave second spraying with Bordeaux. Sodium nitrate half with less tip burn than the manured half, and sprayed vines somewhat better than unsprayed. *August 13:* Gave third spraying with Bordeaux. Very little early, and no late blight. Sprayed rows somewhat better than unsprayed. *September 11:* Vines nearly all dead except a few scattered ones. Sprayed vines showed less difference over unsprayed this year than any other, due no doubt to the fact that drought was bad and the first spraying was not given until tip burn began to show its effects on the vines. No blight at all.

Results: The spraying this year gave the least results of any year, showing only an average increase of 17 per cent. over the unsprayed. Had the first spraying been made earlier, there would no doubt have been less injury from tip burn, with a consequent increase in yield. As the drought affected the manured rows most, the increased yield due to spraying was least in these. The sprayed manured ridged gave 12 per cent. increase over the

unsprayed, while the sprayed manured level gave only 5 per cent. increase over the unsprayed part. On the other hand, the sprayed sodium nitrate ridged gave 46 per cent. increase over the unsprayed rows, while the sprayed sodium nitrate level gave 20 per cent. increase over the unsprayed portion. See Table IV.

TABLE IV.—SPRAYING EXPERIMENTS IN 1908.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	Sc P. Ce
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
1) Sprayed (3), Manured, Ridged	1	1	71	23¾	128	20½	200	45¼	55	2¼	0	5
2) Unsprayed, Manured, Ridged	0	0	56	20¼	126	20¼	182	40½	103	3¼	0	4
3) Sprayed (3), Sod. Nitrate, Ridged	1	¼	61	21¾	75	11½	137	34	31	1¼	0	2
4) Unsprayed, Sod. Nitrate, Ridged	0	0	44	13¼	67	10	111	23¼	39	1½	0	2
5) Sprayed (3), Manured, Level	0	0	69	24½	163	23½	232	48	106	3¼	0	7
6) Unsprayed, Manured, Level	0	0	77	24	158	21¾	235	45¾	174	5¼	0	5
7) Sprayed (3), Sod. Nitrate, Level	0	0	40	12½	120	17¼	160	29¾	76	2¼	0	5
8) Unsprayed, Sod. Nitrate, Level	0	0	43	12¼	92	12½	135	24¾	56	2¼	0	4
Average—Sprayed	1	0	60	21	122	18	182	39	68	2	0	5
Average—Unsprayed	0	0	55	17	111	16	166	33	93	3	0	4

Details of Experiments in 1909.

Treatment. Used Green Mountain variety this year, not planting until *May 11*, as the season was late. Gave all a couple of sprayings with arsenate of lead for bugs on *June 24* and *July 7*. About the middle of July gave first ridging, and the final one on *July 27*, when first treatment with Bordeaux was also made. *August 9:* Made second spraying with Bordeaux. *September 2:* Gave third spraying with Bordeaux. Sprayed rows now much greener than unsprayed, especially those ridged, as the vines in the unsprayed ridged rows were all dead from tip burn. *September 28:* Vines all dead except one here and there. No late blight, and very little early blight. Practically all of premature dying due to tip burn.

Results. The spraying this year gave the best results of any of the four, since the average increased yield was 53 per cent. The yields this year were better than any other year except 1906. The sprayed manured ridged gave an increase of 45 per cent. over

the unsprayed manured ridged, while the sprayed manured level gave 48 per cent. over the unsprayed check. On the other hand, the sprayed sodium nitrate ridged gave 60 per cent., and the sprayed sodium nitrate level 79 per cent. over their unsprayed checks, the last being the greatest increased yield due to spraying obtained in any of the experiments during the four years. See Table V.

TABLE V.—SPRAYING EXPERIMENTS IN 1909.

Treatment	Very large		Large to medium		Medium to small		Total marketable		Very small		Rot No.	Scab Per Cent.
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
(1) Sprayed (3), Manured, Ridged	4	3½	64	24½	212	39½	280	67½	79	3¼	0	77
(2) Unsprayed, Manured, Ridged	0	0	44	15	185	31½	229	46½	73	2¾	0	84
(3) Sprayed (3), Sod. Nitrate, Ridged	5	4½	50	18	108	17½	163	40	28	1¼	0	66
(4) Unsprayed, Sod. Nitrate, Ridged	0	0	34	11½	91	13½	125	25	28	1¼	0	67
(5) Sprayed (3), Manured, Level	0	0	61	22	242	39½	303	61½	173	5½	1	60
(6) Unsprayed, Manured, Level	0	0	46	16	184	25½	230	41½	139	5¾	0	65
(7) Sprayed (3), Sod. Nitrate, Level	0	0	51	18½	145	21	196	39½	78	2¼	0	46
(8) Unsprayed, Sod. Nitrate, Level	0	0	29	9	108	13	137	22	89	2½	0	42
Average—Sprayed	2	2	56	21	177	29	235	52	89	3	0	62
Average—Unsprayed	0	0	38	13	142	21	180	34	82	3	0	64

Recommendations.

(1) *Seed.* The blight fungus carries over in the tubers, and the infected ones may be recognized in the spring by the slightly sunken, often pitted, reddish-brown, superficial dry rot. While the use of such tubers is not advisable, still blight may do much harm in a field in which the seed tubers were perfectly free from the fungus. As to varieties, we know of no good standard variety grown in this state that is not subject to blight of the vines and rot of the tubers, though there may be more variation in the latter respect than in the former. Such varieties as have been found by experiment to possess more or less resistance to either blight of the foliage or rot of the tubers seem to have it at the expense of quality of tubers. However, this is a subject for further investigation, and probably offers greater possibilities than have yet been developed.

(2) *Planting*. For early varieties early planting, in order to mature them as soon as possible to escape injury by blight or drought in midsummer, is no doubt advisable. But for late varieties we rather favor only medium early planting, say the last of April to the first week of May, because if planted too early, late potatoes suffer more in the years of drought than if planted later, since they are usually so far matured that a dry July or August will kill them, while the later planted fields, especially if sprayed, will manage to pull through until the moist fall season, and so really have a longer period of growth. We recommend that the seed be planted fairly deep, five to seven inches, to develop the tubers in the ground as deeply as possible as a protection against rot and sun scald.

(3) *Rotation*. We advise rotation, having potatoes on a different piece of land each year. A four years' rotation, such as the following, is not bad for this state: (1) Corn. (2) Potatoes. (3) Rye. (4) Leguminous crop (sow in fall with the rye, or the following spring). Growing potatoes on the same land two or more years in succession increases scab and possibly in favorable seasons an earlier appearance of blight and greater rot, though so far as the blight is concerned this is largely conjecture.

(4) *Fertilization*. Manure plowed into the land in spring just before planting the potatoes increases the amount of scab and possibly the amount of rot in blight seasons. If a heavy coat of manure was used with the corn the previous year, commercial fertilizers only may be used with the potatoes. Or if manure is used, plow it in the preceding fall. Horse manure is probably the least objectionable. The following home-mixed fertilizer (per acre), recommended by Dr. Jenkins, seems to merit extended use in this state: Nitrate of soda, 150 lbs.; muriate of potash, 200 lbs.; acid phosphate, 400 lbs.; tankage, 350 lbs.

(5) *Cultivation*. We recommend a thorough cultivation, to conserve the moisture, in the nature of a combined level-ridge culture. That is, give the vines thorough level culture up to the last two cultivations, and then begin sometime early in July to ridge up the rows with the shovel cultivators, moderately at first, and as much as possible the second time. After both of these ridgings, mulch up the soil between the ridges by shallow cultivation as much as possible without pulling down the ridges, so as to hold in the moisture. This ridging, we think, protects the tubers

more against rot, by burying them deeper under the soil, so that the blight spores are not washed down to them so easily. It also gives better ventilation to the vines, by allowing water on the foliage to dry off quicker, and by holding the vines erect and off the ground makes spraying easier and more effective.

(6) *Spraying.* As year after year, wet or dry, we have got increased yields due to spraying potatoes with Bordeaux mixture (4-4-50), we recommend the spraying as a yearly feature in growing late potatoes in this state. The spraying should be done thoroughly, whether by hand or by power, which means that it will take from two to three barrels of the mixture per acre. With the ordinary horse-power sprayers using fixed nozzles, it is necessary to go over the rows twice, in opposite directions, at each spraying, in order to properly coat the vines. The first spraying should be given about the first of July, and if desired, an insecticide, either Paris green, rate of ½ lb., or arsenate of lead, rate of 3 lbs., to 50 gallons of Bordeaux, may be added. We do not believe from our trials with various other sprays that there is anything as good for potatoes as the home-made liquid Bordeaux mixture.

For the late blight alone, the middle of July is early enough for the first spraying, but we advise the first of July, since better results against tip burn and early blight may be expected, and then, too, by the middle of July it is more difficult to reach the lower parts of the vines when a luxuriant growth has been made. The number of times of spraying will depend upon the weather and the manner of spraying. When it is done with leads of hose by men on the ground, only three or four sprayings are necessary. When stationary nozzles attached to the back of the wagon are used, whether the power is furnished by hand or by horse, it will take from four to seven sprayings, depending on the weather, to do good work. In any case it is essential that the vines be kept covered with spray up to the time of their death, otherwise the blight may develop slowly on the green foliage in the fall, and while doing no harm in preventing tuber formation, may work great havoc by rotting the tubers already formed by the spores washing down on them. See Plate XXXVII a.

III. OÖSPORES OF POTATO BLIGHT, *Phytophthora infestans.*

Importance. Very few fungi have caused the serious and widespread injury that in certain seasons has been wrought by the potato blight. So great was this damage in Europe about 1845, that three governments appointed commissions to investigate the trouble and determine surely the cause, as there was considerable difference of opinion on this latter point. In North America the blight was very destructive at the same time. Thoreau, in his book "The Maine Woods," written about 1846, says: "The potato rot had found him out here, too, the previous year, and got half or two-thirds of his crop, though the seed was of his own raising." A similar condition existed in Canada, as shown by a letter written in 1844 to Dr. Bellingham of Dublin (see Berkeley in Journ. Hort. Soc. London 1: 11. 1846), which reads as follows:

> During the months of July and August we had repeated and heavy showers, with oppressive heat and an atmosphere strongly charged with electricity. Toward the close of the month of August I observed the leaves to be marked with black spots, as if ink had been sprinkled over them. They began to wither, emitting a peculiar offensive odor; and before a fortnight the field, which had been singularly luxuriant and almost rank, became arid and dried up, as if by a severe frost. I had the potatoes dug out during the month of September, when about two-thirds were either positively rotten, partially decayed and swarming with worms, or spotted with brownish colored patches, resembling flesh that had been frost-bitten. These parts were soft to the touch, and upon the decayed potatoes I observed a whitish substance like mould.

Concerning the condition at this time in Europe, Berkeley, in the article mentioned above, writes: "Few subjects have attracted more attention, or have been more variously canvassed than the malady with which potatoes have been almost universally visited during the autumn of 1845." Since that great outbreak, which resulted in famine in Ireland, the blight has been frequently reported in the potato districts of the cooler temperate regions, but only under special conditions of moisture, such as rainy or foggy weather of some duration in July and August, has it developed in epidemics of widespread and unusual importance.

When the writer first came to this station in 1902, the potato blight was at the height of one of its periods of destructiveness. In that year the injury resulted largely from the very premature killing of the vines, some fields going down in a week during the latter part of July. In 1903 the vines were killed somewhat prematurely, and there was serious rotting of the tubers. This tuber rot was even more serious in 1904, being in fact more destructive in this respect than in any other of the ten years in which we have gathered data. Correspondence at the time with farmers over the state brought out the following items: J. B. Gelston, East Haddam,—"almost a total failure"; Vine Hill Farm, Elmwood,—"lost about sixty per cent. of crop"; W. S. Thomas, Groton,—"saved about one-third of crop"; W. S. Lee, Hanover,—"I probably lost three-fourths of my crop"; W. M. Shepardson, Middlebury,—"about one-half crop rotted"; E. Healey, Mystic,—"I think three-fourths rotted before they were dug"; C. M. Ladd, North Franklin,—"estimated two-thirds crop rotted." Since that year there has been comparatively little injury in the state from blight, especially during the dry years from 1907 to 1909. In 1910 some little rot started, but the vines were too far gone from tip burn before the appearance of the blight for it to get a good start.

With the reappearance of a season having a wet or muggy July and August, we may expect further outbreaks of this trouble. The work of this and other stations, however, has shown that much of the injury may be prevented by spraying and other protective measures, and that an increased yield even may be expected by spraying in seasons with practically no blight. (See preceding article, also our Report for 1904, p. 363.) This part of our object in studying potato blight has been largely accomplished.

Historical Interest. Another feature of potato blight that is of especial interest is its historical importance from a botanical standpoint. Some idea of the early study made of it is well illustrated by the following extract, published in 1846 in The Amer. Journ. Sci. and Arts, vol. 2, page 281, and written by J. P. Norton:

Little has as yet been done on any organized plan in this country (United States). In Europe the case has been very different. In Holland and Belgium a committee was first appointed to collect facts calculated to

throw light on the nature of the disease. In one of the Dutch provinces, Groningen, a separate commission was appointed for the same purpose. In Germany, Liebig, among others, has turned his attention to the potato, and has lately published some observations on its nitrogenous constituents. A number of the French philosophers, both alone, and under the auspices of the Central Society of Agriculture, have also attended to the subject. M. Payen has lately published three or four reports containing the results of elaborate microscopic and chemical researches.* The English government sent a commission to Ireland of three distinguished scientific men, with directions to obtain as much information as possible on the nature and extent of the disease. In Scotland originated the most extended schemes of all. The subject was taken up in its several branches, as it is connected with botany, meteorology, entomology, and chemistry. Each branch was referred to a competent person, and the investigation is still in progress.

Object of Investigation. Many investigators since have made careful studies of the life history of this fungus. Considerable interest was excited by the Smith-De Bary controversy concerning its disputed winter spore stage, known as oöspores. It is upon this point that the writer has become especially interested by reason of several years' study of the fungus in artificial cultures. Our object was to secure these oöspores in cultures through the use of special strains of the fungus or by particularly favorable cultural media, since in our first cultures no indication of their existence was revealed. In this respect we have finally been successful, though their abundant production has not yet been accomplished. We have made a special study of cultural media, environmental conditions, etc., in the hope that some light might also be thrown on the related question why certain stages of a fungus, usually the conidial ones, are grown readily in artificial cultures, while other stages, usually the mature one, rarely if ever appear, though not uncommon in nature. We cannot say that we have yet accomplished much in this direction, though it often takes tedious preliminary work of seemingly little importance to lead up to the final successful results.

Previous Work by Others. We have referred to the Smith-De Bary controversy, carried on in the seventies over the so-called oöspores of potato blight. The former claimed to have found these sexual spores in old leaves and tubers injured by the blight fungus. The latter, a more careful investigator, failed to find any oöspores of this nature that he could connect with the blight fungus, and he threw so much doubt on the conclu-

sions of Smith that botanists generally have regarded that the existence of these oöspores has not been proven. Since that time other investigators have claimed, on a few occasions, to have found bodies like immature oöspores. The writer has found various suspicious bodies in the leaves and tubers of infected plants, but has never been convinced of their real nature. Some of these bodies are much like oöspores in appearance, but in our experience they have never been so abundant or typical as to convince us of their connection with the blight fungus. Plate XXXIX G-I shows some of these bodies which are easily distinguished from the true potato oöspores shown above.

Two French investigators, Matruchot and Molliard, were apparently the first to grow the blight fungus in artificial cultures. Their reports were made in 1900 and 1903. They were not successful in gaining any light concerning the oöspores from their cultures.

In 1904 the writer first made artificial cultures of the blight fungus, and about this time Jones and his assistants at the University of Vermont took up the study of the fungus in the same manner. The results of their work have not been published in detail, though the main points have been presented in two papers before our botanical societies, and brief abstracts of these have appeared in Science. In their work, so far as published, they have had more success than the writer, up to the present investigation, in obtaining curious, immature, and apparently somewhat abnormal bodies, apparently of an oögonial nature, but whose exact identity was left in doubt, since there were no signs of antheridia or of oöspores. The writer previously has been inclined to call these bodies chlamydospores. From the results of our present investigations we believe that they are essentially abnormally and imperfectly developed oögonia (possibly functioning as chlamydospores) due to lack of fertilization by normal antheridia.

Previous Work by the Writer. The results of our previous work with the blight fungus in artificial cultures have been presented in the Reports of this station for 1905 (p. 304) and 1908 (p. 891). In these investigations, while we occasionally obtained swollen and differentiated threads in the cultures, we were unable to produce these at will, or to further their development, so their nature was largely a matter of speculation. Jones and

his assistants in the meantime had been much more successful with the development of these bodies, but with culture media much less suited to the vigorous development of the fungus. Our efforts, however, were rewarded at the time by learning how to best obtain cultures of the fungus, and what media were best suited to its luxuriant development. In this respect we believe our cultures have proven better than any of those yet attempted. The Lima bean juice agar described in our Report for 1908 was up to that time the most satisfactory of these media. It has been by continued efforts to develop a specially favorable medium that, for the greater part, we have finally accomplished the desired results.

Present Investigations.

Nature of Work. We shall give in the following pages the general results of our recent endeavors to produce the oöspores of *Phytophthora infestans* in artificial cultures. A short preliminary account of this work has recently appeared in Science, vol. XXXIII, p. 744. We wish here to acknowledge indebtedness to our assistant, Mr. E. M. Stoddard, who has made most of these cultures under our direction, and has been very helpful in determining the results thus obtained, since it has required hundreds of cultures, and the examination of these several times, to obtain the required data. The main lines of procedure have been to secure favorable strains of the fungus for the work, and to induce these strains to produce oöspores by means of favorable media or special environment. We shall discuss these points in detail in the following paragraphs.

Strains. The cultures used in our previous work were lost or allowed to die out from time to time, so that these reported here are from different sources, except the one from Holland. These strains, besides representing a variation in origin, also present different lengths of time of growth in artificial cultures. For example, we have continuously grown the Holland strain, A, for over two years, and we do not know how much longer Professor Jones had it in culture; while the E strain has been cultivated less than two months. There seems to be no diminution in the vigor of their growth under continued artificial cultivation, though we do not know whether or not their power of infecting potato plants has declined. They all still retain this

power, however, as determined by recent tests. These strains are designated by letters, A, B, C, etc., as a matter of easy identification. They have exhibited some slight variation in the luxuriance of their mycelial and conidial development, and even more in the matter of oöspore production. A short description of their source of origin, development, etc., follows:

Strain A. This was obtained about February, 1909, from Jones, who isolated it from tubers grown in Holland. From this culture we have grown at least twenty-two generations, represented by many cultures under varying conditions. It has formed a very fair growth on suitable media, though it is the least vigorous now of any of the strains. It was the first in which we noticed the appearance of imperfect oögonial formation, though this was perhaps more owing to the medium employed than the strain, since the B strain soon afterwards gave even better results in the same medium. It now stands about fourth in the matter of oöspore production, being less variable than D, but the oöspores produced are never very abundant, and are usually imperfect.

Strain B. This culture was isolated by the writer in November, 1909, from tubers furnished by Mr. Ellicott Curtis, and grown at Bantam, Conn., that year. His crop had been sprayed during the season and kept green until late in the fall, when the rains washed off the spray, and the blight got a foothold too late to injure the vines much, but enough to thoroughly infect the tubers, which were dug very late, and found to be badly rotted. We have grown this strain for at least nineteen generations, perhaps in more cultures and under more different conditions than any of the other strains. It makes a good vigorous growth, perhaps the best of any, though not always the most luxuriant. On the whole, the best results in oöspore production have been obtained with it. The most perfect oögonia, antheridia and oöspores have also been found in cultures of this strain.

Strain C. Cultures of this strain were obtained by the writer in January, 1910, from infected tubers purchased at a Westville grocery, and probably grown either in Maine or Long Island. About fifteen generations have been grown in cultures after the manner of A and B. For a long time this strain gave no indication of oögonial formation, though grown continuously on the medium most favorable for that purpose. About the tenth generation immature oögonia were first noticed, and succeeding generations developed these better and more abundantly, until finally antheridia also began to appear, and somewhat rarely, mature oöspores. At present it ranks about third as regards oögonial development. It ranks high in conidial production.

Strain D. This strain was separated by the writer in October, 1910, from the descendants of diseased tubers obtained from Mr. Curtis (see Strain B) and grown in 1910 on our experimental farm at Centerville. It has the general characteristics of B, and has given some cultures with a good development of oögonia, antheridia and mature oöspores, but as

yet it seems much more variable than B in this respect, and so not to be depended on, though it has not been in culture nearly so long, as it has been carried through only seven generations. However, it now stands about second in oöspore production.

Strain E. Mr. Stoddard obtained this strain in February, 1911, from Maine grown tubers purchased at a local grocery. As yet it has not been thoroughly tested, as comparatively few cultures have been made, represented by only three generations, but in these oögonial production has not made its appearance even in a slight way.

Media. Synthetic media, because of known composition, offer the best means for determining the cause of oöspore production, if such depends on some particular chemical substance or element. Yet such media, especially when in liquid form, are not as favorable for general growth of fungi as media containing vegetable nutrients whose ingredients are quite complex and whose exact chemical nature cannot be determined. Consequently, we have not used synthetic media except in the sense that certain substances of known composition have been added to our vegetable media to determine their individual effect. Potassium and phosphorus are more or less fixed in literature as having importance in vegetable reproduction, and yet we have not in any way by the addition of potassium phosphate increased oöspore production in our cultures. Likewise, toxic or stimulative substances have an influence on vegetative growth, yet such substances as we have tried in a small way, copper sulphate, chloroform, ether, etc., have given no response in increased oöspore production.

Various Media. Most of our cultures have been on vegetable media, usually in combination with agar-agar. We have tried some few liquid media, but they have shown no special advantage, such as might be expected from the supposed relationship of *Phytophthora* and *Pythium*, and the reported favorable development of the oöspores of the latter in liquids. Likewise, we have not found gelatine a favorable medium in what little use we have made of it, though this was used largely by Jones in his cultures. In our work, besides various agar-agar media, we have tried a considerable variety of substances and combinations. We have used living aseptic vegetable tissues and quite a number of sterilized ones, either in whole or ground condition. We have also used filter paper soaked with nutrient liquid. Taking into consideration all of the various media, and their modifica-

tions, we have tried about seventy-five different combinations in over 1,200 cultures.

Most Favorable Media. Out of all these combinations, three media stand out as being especially favorable for the growth of the fungus. Of these the Lima bean juice agar was described in a previous paper. (Report, 1908, p. 898.) This has never given us mature oöspores, and immature ones only once. A second very favorable medium for aërial growth of the fungus, perhaps the most favorable of any we have used, is a "combination medium" consisting of the following ingredients, ground to powder in a food-chopper: Lima beans, 15 grms.; oats, 25 grms.; peanuts, 10 grms.; potato, 15 grms.; sweet corn, 10 grms.; wheat, 10 grms.; with agar, 10 grms., and water, 500 cc. This, however, has shown no special virtue so far as oöspore production is concerned. Potato juice agar gives a fair mycelial growth of the fungus, but not as luxuriant or vigorous as the other two media mentioned here. It needs to be used for the best development somewhat stronger than we first tried it, and we are now using at least 300 grms. of the sliced tubers to 500 cc. of medium. But potato juice agar, like the preceding, has so far been of no value in producing oöspores. The one medium that has stood alone so far as production of oöspores is concerned is our oat juice agar. Without this, apparently, we would never have produced perfect oöspores in cultures.

Oat Juice Agar. We have varied somewhat from time to time in the manner of making this, but in order to have as uniform a product as possible, we have finally adopted the following method: Fifty grms. of ground oats, such as are ordinarily fed to horses, are stirred into about 300 to 350 cc. of water, and steam from an autoclave, by means of glass and rubber tubing connected with the stopcock, is run into this in a covered dish for half an hour. This cooks the material without burning and at a uniform temperature. The coarse sediment of the oats is then strained off through an ordinary fine wire strainer, and 10 grms. agar is added to the liquid, which is again treated to the steam for half an hour to thoroughly melt the agar. Some water passes over with the stream during these cookings, so that what little, if any, is needed to bring it up to the required 500 cc. is added after the whole is drained into a graduated cyclinder. After the added water is uniformly distributed by repouring, the

medium is placed in the test tubes and these are sterilized in the autoclave for fifteen minutes under 7 to 10 lbs. pressure.

Chemistry of Oats. We are not sure what particular ingredient of oats, if any, is responsible for stimulating oögonial development in the oat juice agar. Chemical analyses of oats show that they have higher percentages of ash, fat, and lecithin than the other cereals. Taking the ash content; however, it seems that this higher per cent. is due largely to silica, so that the percentages of phosphorus and potash are even lower than in most of the other cereals, as well as in beans, though perhaps higher than in potatoes. So these constituents of the ash are apparently not the favorable factors. While the licithin is higher than in the other cereals and potatoes, it is lower than in beans. On the other hand, the fat is considerably higher than in the beans, or any other cereal except corn, which it slightly exceeds.

Lecithin is phosphorized fat (contains fatty acids, cholin and esters of phosphoric acid), and is more soluble than ordinary fat, being the form in which it is said by some to be digested. According to Loew*: "By the transformation of fatty matter into lecithin the higher fatty acids are offered to the protoplasm in a soluble form, and after being oxidized, other molecules of fatty acids may enter into the place of the former, and thus the same molecules of the glycerol-phosphoric acid can serve repeatedly as vehicles for the oxidation of fatty acids." In this manner the amount of lecithin really available in the oats, because of the much higher per cent. of fat, may greatly exceed that of the bean. Lecithin also, according to Loew, has considerable therapeutic value in cases of nervous debility, and is a high constituent of the nervous system (and it is also a prominent constituent of the spermatozoa of animals), and this might explain its value in stimulating the potato blight to sexual reproduction, especially in its effect on the antheridia, which seem to have most nearly disappeared.

Fat alone, possibly because not available for the fungus, does not explain the production of these oöspores, since corn, though but little lower than oats in its fatty content, did not stimulate their production. Likewise peanuts, very high in fat and probably higher in lecithin, failed to even produce a mycelial growth of this fungus, though several other fungi grew rather vigor-

*Bull. 45 Bur. Pl. Ind. U. S. Dept. Agr.

ously in the peanut juice agar. The fat is so evident in this medium that it shows plainly, even when only 25 grms. of ground peanuts are used per 500 cc. of medium, which is not the case with our oat juice agar. While the comparatively high per cent. of fat in oats, and the possibility of its easy conversion into lecithin, might explain the phenomenon of oöspore production in the potato blight fungus, we have no sure proof that this is so. In any case the fungus seems to "feel its oats" more or less.

Likewise, this oat medium seems to stimulate ordinary spore production with some other fungi. For example, *Monochætia Desmazierii* fruits abundantly in it, whereas it does not fruit at all, or very little, on several other media in which we have grown it. We have also several times had the sclerotia of *Sclerotinia Libertiana* attempt to form its asco stage in this medium, by developing long stalks which just fail to expand and develop the terminal fruiting cups. Several other fungi also produce in this medium a more luxurious fruiting condition than they do in the other media in which we have grown them.

Environmental Factors. Having secured this favorable medium and using the various strains at hand, we have attempted to determine if certain changes in the medium or its surroundings might not act more favorably on oöspore production. We will briefly discuss these factors in the following paragraphs. In summary, however, it may be stated that we have not found any very decidedly favorable factors, though there seem to be "tendencies" in certain directions, and that as yet we fail to uniformly insure or gradually increase oöspore production by taking advantage of these apparently favorable conditions.

Acid versus Alkaline Media. As made up by us, oat juice agar takes about 15 cc. of $\frac{N}{10}$ NaOH to neutralize 250 cc. of the natural medium, as determined by the phenolphthalein test. In order to test the effect of acid, neutral, and alkaline oat agar the following strengths were made at different times and the potato blight fungus grown in them: (1) 15 cc. acid (natural medium); (2) 5 cc. acid (used 10 cc. of $\frac{N}{10}$ NaOH to neutralize 250 cc. of medium); (3) neutral (used 15 cc. of $\frac{N}{10}$ NaOH,

etc.); (4) 5 cc. alkaline (used 20 cc. of $\frac{N}{10}$ NaOH, etc.); (5) 15 cc. alkaline (used 30 cc. of $\frac{N}{10}$ NaOH, etc.) The strains A to D acted somewhat differently on these five strengths,* but as a rule vigorous mycelial growth occurred only on the 15 cc. and 5 cc. acid, and practically no growth on the 5 cc. and 15 cc. alkaline tubes. However, by gradually acclimating the various strains through the different strengths from the natural 15 cc. acid, they were all finally brought so that they would grow more or less on the 15 cc. alkaline tubes.

As regards oöspores, they formed less abundantly and more imperfectly on the alkaline tubes than they did on the acid tubes. On the whole, perhaps the 5 cc. acid tubes gave the best results, though in some of the comparative tests the 15 cc. acid and the neutral media did as well or even better. We had thought that perhaps a slightly alkaline medium would favor oöspore production, since in previous work with the Lima bean mildew (*P. Phascoli*) we had found that by making the medium slightly more acid we had first cut off oöspore production, then conidial, and finally the mycelial development itself, and our first results with the potato blight seemed to indicate that a neutral or less acid medium than the natural oat juice agar favored better oöspore development. Out of the total of our experimentations, however, we can only say that alkaline oats agar is apparently less rather than more favorable, and that between neutrality and 15 cc. acidity is the best condition for oöspore production as far as this particular factor is concerned.

Light and Darkness. Some investigators have found that light favored spore germination in the smuts. We tried strong light, partial and total darkness, to see if light or its absence had any effect on oöspore production. Cultures kept in a jar exposed to full light of a north window made a less vigorous growth than those kept in an adjacent jar entirely protected from the light, while neither did quite as well as the cultures kept under our usual conditions of partially diffused light (in the same room in a glass front cupboard in open tin cans, for

*For instance, one tube of C grew fairly well on the 15 cc. alkaline tube when transferred directly from the 15 cc. acid tube.

convenience in holding them). Neither did those cultures exposed to the stronger light or those in total darkness show an increase in oöspore production, as the difference, if any, was in favor of our ordinary conditions of partially diffused light.

Temperature. The fact that ordinarily we have found the oöspores of *P. Phaseoli* on beans in the fall, about the time of the first frosts, indicated, as is the case with many other fungi which develop their mature stage in late fall or early spring, that cold is an important factor in the production of the sexual stage. Our experiments along this line, however, gave no indication that oöspore production in the potato blight could be stimulated in this manner. Comparative tests were made, and repeated with similar results, under four different conditions of temperature, the temperatures being taken three times a day during the duration of the tests. (1) Cultures were kept in an incubator varying from 29 to 33° C., and averaging 32.6°. (2) In another incubator they were kept at a temperature of 24 to 27° and averaging 24.6°. (3) Check cultures were kept under our ordinary room conditions of 16 to 22°, averaging 19.4°. (4) Cultures were kept in a box connected with an indirect ventilator to the outside of the building, in which the temperature ranged from 1.5 to 20°, averaging 14.5°.

The results of these tests showed that the fungus failed to grow at all in the higher temperatures of the incubators. The best growth was made under our ordinary room conditions, where the temperature averaged 19.4°. The cultures that were kept in the low and quite variable temperature, averaging only 14.5°, did very well and made fair growths despite these conditions. It would seem that the best temperature conditions for mycelial growth of the fungus were between 15 and 20°.

These temperature tests agree with the general prevalence of the disease in our more northern temperate regions, and its most severe outbreaks in seasons that are slightly below the average in temperature as well as above it in moisture. However, in spite of the great variability with those cultures grown under the colder conditions, there was no indication of increased vigor in oöspore production. In fact, these tubes did no better, if as well as the check tubes, under our ordinary temperature conditions. Low temperature, then, does not seem to be the factor determining oöspore production in this case.

Air. So far as we have seen, oöspore production takes place in the medium slightly below or at the surface of the agar. In fact, this, as well as most other fungi when grown on agar media, makes only a slight invasion into the medium itself. Jones, in his experiments with this fungus, however, seems to have used stab cultures to a very large extent, and here the oöspore-like bodies were produced deep in the medium, away from the air. We have not used stab cultures largely, but so far as we have tried them we have not obtained oöspores as abundantly or as perfectly developed as in the ordinary agar slant tubes. Jones, however, used gelatine in the place of agar. We have not used this in our work nearly so much as the agar, but so far as we have tried it we have not found it as desirable as agar. It would seem from our work that the exclusion of the air by stab cultures in gelatine media was not necessarily a favorable factor in oöspore production, and that Jones got his results in spite of, rather than because of, this condition. Possibly the strains he used were the real factors in his partial success.

Moisture. Moisture seems to be a very important factor in the spread of the potato blight fungus, since infected leaves of a plant, if kept in a dry atmosphere, develop the disease no further. Likewise, in cultures there seem to be certain conditions of moisture most favorable for success, but here excessive moisture is as unfavorable as too little moisture. Cultures inoculated into the base of a tube containing water do not do so well as those inoculated above and kept free from the water. Likewise, as a general rule, cultures inoculated toward the base of a tube do better than those inoculated in the drier upper edge. We have had the best results by inoculating the tubes at the base, if not bothered by water there, inserting a small amount of the medium with the fungus, and slightly imbedding this into the agar.

The chief difference in a tube seems to come in the production of the oöspores, which if present are most likely to be found in the upper and drier part of the tube. Whether the passing of the fungus from the more moist lower portion into the upper and drier portion (dries out quicker because thinner) explains this we do not know. We do know that the use of either a more or less dilute agar (we ordinarily use 10 grm. to 500 cc. of water) does not increase oöspore production to any appre-

ciable degree. We have tried rolled tubes in a few cases, inoculating them at the base. These dry out much quicker than the ordinary slant tube, but we cannot say that they gave us any very unusual results. We have also tried running the water, when present in the base of the tubes, over the growth occasionally, and have pulled off the aërial growth every few days, but neither of these methods gave us unusual results as regards the oöspores. We have also tried growing the fungus in Petrie dishes, which offer a difference in moisture conditions, but our luck here has been no better than with the tubes.

While speaking of the Petrie dish cultures we might mention that we devised methods by which, with temporary slips of paraffined paper, we could pour a plate containing from two to four different kinds of media. Inoculating these at the center, the fungus gradually spreads out over these different media; or by a special contrivance it can be made to pass successively from one kind to another. But these variations have not given any particularly favorable results in oöspore production.

Clear versus Sedimentary Media. Besides stab cultures in a gelatine medium, a third factor in which Jones' methods have differed from ours has been his use of a clear or filtered medium, while we have largely used sedimentary media, in which only the coarser food particles have been filtered off. That his use of filtered media does not explain his partial success in imperfect oöspore production seems apparent, since we failed in our previous experiments to obtain oöspores under conditions employed by him, so far as the use of stab cultures in a filtered, potato juice gelatine goes. So it must be some other factor than this that gave him oögonia where we failed to obtain them. In fact, we have found with our oat juice agar that the sediment in the medium favors rather than retards oöspore production.

On several occasions we have placed a batch of hot oat agar in a centrifuge and whirled it in the machine for ten to fifteen minutes, until it hardened, when we have been able to cut off the upper perfectly clear portion from the lower portion containing the extra sediment. Comparative cultures made in tubes of the clear and sedimentary portions have always shown that the fungus makes a much weaker growth in the former, and so far no signs of oöspore formation have been found in it, while in the sedimentary tubes the mycelial growth and oöspore

production remain about the same as in our ordinary tubes, from which they differ only in a little more sediment. Tubes made from oats in which none of the coarse sediment is removed also act about the same as our ordinary tubes with only the finer sediment present. Since it might be that the clear tubes were very deficient in soluble food matter, we have made cultures in which the ground oats were soaked over night in water, protected from bacterial action by chloroform, and then used this for making the oat juice agar. The clear and sedimentary portions of such a medium, separated in a similar manner in the centrifuge, showed no different results than before on inoculation with the fungus. It seems from these experiments quite evident that the fungus gets from the solid food particles in the sediment something favorable not only for more vigorous mycelial development, but also for inciting moderate oöspore production. Whether or not it is the fat, which might be beld in greater amount in the sediment, we have not determined.

Variability of Oöspore Production. Despite the fact that oat juice agar will usually produce oöspores with most of our strains, while Lima bean juice agar practically fails to do so, there still remains much to be desired in stability and productiveness of oöspore formation in this favorable medium. In fact, we are never sure even now when we make a culture from a very good tube as regards oöspores that its descendant tube will be equally good. While our success in obtaining oöspores to-day is much greater than it was over a year ago, when they first began to appear, it is only in looking back over this long period that we notice improvement, since cultures made a month or two ago may have been even better than those of recent date.

Variability in the Same Tube. Just what causes this variability of oöspore production we do not know, since it manifests itself even in the same tube. We have mentioned before that ordinarily we are more likely to find the oöspores at the top of the culture than anywhere else. We may take out for microscopic examination small pieces of the medium from several different places, and find no oöspores, or only a few, and then we may strike a spot where they are rather common. This may be due to the fact that localized portions of the mycelium are concerned in their production, and that these are scattered. We have some evidence in favor of this view in the oöspore pro-

duction of *P. Phaseoli,* where we find oöspores more abundant in some places than in others, and occasionally we find them developed in more or less luxuriant bands, so evident as to be detected by the naked eye. Yet with this species it is rare that they do not occur very abundantly in every slide made from the surface of an oat agar tube; while the opposite condition is more likely to be true of the potato blight. Perhaps this restriction and scarcity in the case of the potato blight is due to their development in certain spots where the available food, especially in the sediment, is most abundant.

Variability in Different Tubes. We have also found that cultures made from the same source into tubes of the same batch of the medium may vary considerably. Perhaps variation in different batches of the same medium might be accounted for by some very slight variation in the manner of making, but we would hardly expect this to hold true in the same batch unless it was some variation in the settling of the sediment, too slight to be detected by the eye.

We have tried to increase oöspore production by propagating from tubes showing the greatest luxuriance in their development. While there seems to be something in this, still on the whole we have no very clear proof of it. Perhaps one difficulty in the way is that in these renewals we are never sure that we have used a portion of the culture that was richest in oöspore production, since it is usually impossible to detect their presence with a hand lens in our uncleared media. With Jones' cleared gelatine media, however, this method of renewal was more feasible, as the oöspore groups were quite evident with a hand lens, and this may account for such success as he has attained by his continued use of these oögonial groups.

Age of Cultures as Regards Oöspore Production. As a usual thing, with our oat juice agar cultures we can find immature oöspores in the tubes, if such appear at all, two weeks after inoculation. With *P. Phaseoli* mature oöspores are usually quite abundant by this time. In order to be sure, however, we have usually examined the tubes again about a month after inoculation, as the oöspores are then frequently more mature and abundant. One of the very best tubes produced showed about a hundred oöspores, in different stages of development, on a single slide from it. Ordinarily, however, the number of

oöspores does not run over from six to twenty on a slide, and most of these are imperfect. A slide that will give two or three oögonia from which mature oöspores can be crushed out is considered a good one. Most of the oögonia fail entirely to mature, apparently through lack of fertilization. Those that reach maturity with a perfect oöspore usually have attached a well-developed antheridium. Whether or not we can develop oöspore production to the luxuriance which is the usual thing with *P. Phaseoli* in both Lima bean and oat juice agar, time only will tell. What we are sure of so far is that we have produced perfectly matured oögonia with normal and apparently functional antheridia, and that the oögonia in such cases have often contained mature and apparently functional oöspores. As yet we have not germinated these oöspores, but this is equally true of those of *P. Phaseoli*, as it apparently takes an exposure to winter conditions to bring about germination.

Microscopic Characters of the Oöspores. We have not been able to follow the different steps in the development of these oöspores as closely as in the bean *Phytophthora* because of their comparative scarcity. In general the oögonium develops as a much more prominent factor than the antheridium, since the latter is so frequently missing. Then, too, the oögonium seems to be able to attain a much more advanced stage of development independent of any fertilization than does *P. Phaseoli*, if we can judge by the size and condition of the oögonium in the latter when the antheridium first appears. The oögonia of the potato fungus (see Plate XXXVIII) first made their appearance in our cultures as swollen terminal threads, cut off from the normal mycelium by a septum. Not infrequently, by bifucation of the mycelial thread, there were two of these swollen bodies together. The terminal portion of these swollen threads gradually assumes a globular shape and is cut off from the rest of the thread. In the meantime the swollen thread, especially its spherical tip, becomes more or less deeply tinted. The wall is thickened by the deposition on the outside of the original coat of a more or less irregular, thick, reddish-brown coat (see Plate XXXVIII J). The protoplasmic contents of the oögonium may now begin to contract into the oösphere. If no antheridium is present, however, this seems to be as far as the development toward an oöspore proceeds, and this is the fate of most of the oögonia.

When an antheridium is present (see Plate XXXIX), it is very similar to those of *P. Phaseoli.* We have not yet been able to detect antheridia in their younger stages, having seen them only when they were practically mature, and the oögonium is then well along in its development. With *P. Phaseoli* we found that the antheridium was matured, as to size and general appearance at least, when the oögonium was just beginning to develop. (See Report, 1908, Plate LXXIV E.) Perhaps a similar condition would exist with the potato fungus if the antheridia were produced as abundantly. The presence of the antheridium further stimulates, apparently through fertilization, the protoplasmic contents into forming a definite spherical oöspore with a thin limiting cell wall, which gradually thickens until there is formed a perfectly normal oöspore. Plate XXXIX F shows an oögonium crushed open to reveal more plainly its enclosed oöspore, well filled with protoplasmic contents. In this case the oögonium, antheridium and oöspore are certainly as perfect as any of those ever produced by *P. Phaseoli* (see Plate XL A-C).

The thick, colored, outer wall of the oögonium sometimes becomes so opaque (see Plate XXXIX D) as to hide all signs of its oöspore. This outer coat is also quite variable in thickness and in the irregularity of its markings. Apparently the medium in which it is grown has some effect on the irregularity of the markings as Jones got some apparently quite abnormal sculpturing on those grown in his potato gelatine medium. Then, too, the outer wall is somewhat brittle, and, when slightly crushed under a slide, the thick walled oögonia appear more irregular than they really are. If these oögonia were produced in the plant tissues we doubt if the outer wall would be as thick, or present as great irregularities of surface as it does in the artificial cultures. Some of the oögonia, however, are very nearly smooth, and some have rather thin walls or thin places.

The oöspores have a medium to rather thick wall when mature. This wall is smooth and hyaline, though in some cases we have seen a slight tint and some unevenness of surface. Those we have measured vary from 24 to 35 μ in diameter. The oögonia vary from 34 μ to 50 μ, mostly 38 to 42 μ, depending somewhat on the thickness and irregularity of their outer coat. The antheridia are usually somewhat irregular-oval in shape, vary

in size usually from 14 — 25 × 12 — 18 μ, and, like *P. Phaseoli*, often show the superimposed oögonial thread (see Plate XXXIX D-F). We have not been able to trace the point of origin of antheridium and oögonium, but they seem to come from separate threads, and perhaps it is the contact of these threads that stimulates the beginning of their development, as seems to be the case with *P. Phaseoli.*

Hybrids. In our Report for 1908, page 900, we described attempts to produce hybrid oöspores of *P. infestans* and *P. Phaseoli* by inoculating a tube of Lima bean juice agar above with the former and below with the latter fungus. At first we were inclined to believe that such a hybrid resulted, as in, around, and below the *P. infestans* colony there were developed numerous oöspores. As these did not differ essentially from those of *P. Phaseoli,* however, we finally came to the conclusion that they all belonged to the latter fungus.

When, however, in our present work we tried this same crossing on oat juice agar, the results were entirely different, since we obtained oögonia, usually only in the vicinity of the *P. infestans* colony, which were entirely different from the normal oögonia of *P. Phaseoli* that were produced abundantly all through the culture. These different *oögonia were of the P. infestans type,* which at that time we were just beginning to get in a small way in our pure cultures of *P. infestans* on oat juice agar, and they differed in that they usually *produced mature oöspores, and were far more abundant than we have ever obtained them in pure cultures of P. infestans.* Plate XL shows, in the upper row, the oögonia of *P. Phaseoli* as grown in Lima bean juice agar; the second row shows these *P. Phaseoli* oögonia as grown in a cross culture in oat juice agar with *P. infestans;* while the two lower rows show the hybrid *P. infestans* oögonia as appearing in the same culture with those of *P. Phaseoli* shown in the row above. These photomicrographs easily convince one that the hybrid oögonia are of an entirely different type from those of *P. Phaseoli,* and that they closely resemble those of *P. infestans,* as shown in Plate XXXIX A-F.

As stated before, they differ from those of *P. infestans* in their greater abundance and more perfect development, especially of the oöspores. They also differ, perhaps, in not being so deeply tinted, and there are some that seem to grade into

P. Phaseoli, or at least are not very different from those of that species, as the oögonial walls are only slightly tinted and thickened. In one of these cross cultures we measured fifteen oögonia and oöspores each of *P. Phaseoli* and the hybrid *P. infestans*, and found that in the former the oögonia varied from 24 to 34 μ, averaging 29 μ, and the oöspores from 18 to 26 μ averaging 22.5 μ, while the oögonia of the latter varied from 34 to 47 μ, averaging 40 μ, and the oöspores from 25 to 35 μ, averaging 30 μ. These hybrids, then, are about the same size as the uncrossed oögonia and oöspores of *P. infestans* when fully matured.

We have crossed most of the strains of *P. infestans* with *P. Phaseoli* on two different occasions. Some of these cross cultures have been much better than others as regards production of the hybrid oöspores. We have continued these hybrids in renewal cultures in some cases through six generations. Plate XL, L, shows one of these oöspores in the fifth renewal from the original cross. It does not look essentially different from the original hybrids, as its lighter color is not lighter than some that were produced in the original crosses. Now in these renewal cultures from the original cross, the oöspores are not descendants of the hybrid oöspores, since these never germinate in the cultures, but apparently are merely new crosses each time, and so are produced only by the conveyance of the mycelia of both species, which became closely mixed in the original culture. All of the renewal cultures produce an abundance of the normal oöspores of *P. Phaseoli*, and those cultures which produce few or none of the hybrid oöspores are therefore ones in which the *P. infestans* mycelium has been largely or entirely crowded out by that of *P. Phaseoli*.

Of course there are those who may think that these oöspores are not hybrids, but true oöspores of *P. infestans* which have been stimulated to oöspore production in some way by the presence of *P. Phaseoli*, just as the oat juice agar has stimulated this production to a less degree. We do not believe this to be the case, however. The potato blight has evidently lost its power of antheridial development much more completely than it has its oögonial development. The history of all our cultures shows this to be so. In these cross cultures, the antheridia of *P. Phaseoli* take the place of the missing ones of

P. infestans when situated more favorably to the potato oögonia or oögonial threads than they are to their own. Naturally they are more favorably situated on the whole to their own than they are to those of the potato, and so the hybrids are much fewer in number.

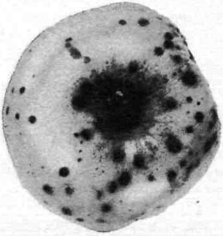
Not only has *P. infestans* been crossed with *P. Phaseoli,* but also with *P. cactorum.* Our results in crossing with the latter, however, have not been nearly so satisfactory, as comparatively few hybrids were found in the cultures, and only where the B and the D strains were used. We think that this is probably due as much to mechanical difficulties in having the antheridia of *P. cactorum* free to fertilize the oögonia of *P. infestans,* as to physiological incompatibility. Our cultures of *P. cactorum* on oat juice agar run almost entirely to oöspore production, with little or no aërial growth of mycelium and conidiophores. This makes it probable that the antheridia are much more favorably situated to fertilize their own oögonia than those of *P. infestans,* so that the chances of crossing are thereby greatly lessened. Those hybrids that were formed were of the potato type, but were not nearly so deeply tinted as those obtained with the bean *Phytophthora,* being more of a golden than a chestnut brown. Photomicrographs of the normal oöspores of *P. cactorum* in a cross culture with *P. infestans* are shown in Plate XXXIX J while K of the same plate shows one of the hybrid oöspores. Four of the hybrids had oögonia varying from 35 to 40 μ, and oöspores from 25 to 28 μ, while the variation of *P. cactorum* in the same culture was 20 to 35 μ for the oögonia and 18 to 28 μ for the oöspores. The oögonia and oöspores of *P. cactorum* are very similar to those of *P. Phaseoli,* being hyaline, smooth, and moderately thin-walled. Sometimes the oögonia of both these species become slightly tinted.

Theories. At one time we suggested as a reason for the absence of the oöspores of potato blight in nature and cultures that there might be male and female mycelial strains and that oöspore production could therefore take place only when these occurred together. So far as our culture work has gone with both *P. Phaseoli* and *P. infestans,* this theory does not seem to hold good, as we explained in our last Report.

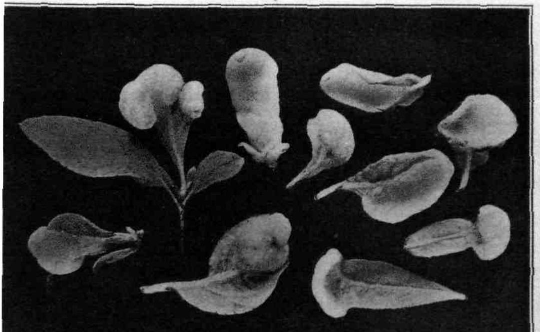
duction to a large degree. This is shown by failure to produce oöspores in media in which both *P. Phaseoli* and *P. cactorum* produce them abundantly. It is further shown by oat juice agar stimulating the production of oögonia in varying degrees from imperfect to fully matured specimens, and by the varying response of different strains of the fungus to this favorable medium.

That the absense of oöspore production is due more largely to the absense or loss of vigor of the male than the female factor, is shown by the appearance of oögonia in cultures more frequently than of antheridia, their evident attempt to form oöspores in the absence of the latter, and their success when normal antheridia do appear. Likewise, the ease with which *P. infestans* crosses with *P. Phaseoli* seems to be due to the vigorous antheridia of the latter species.

It is perhaps idle to speculate as to how this loss of sexual vigor came about, though it may be due to the same cause that has induced the decline of sexual reproduction in the potato itself. Very rarely do the blossoms of the potato set seeds, apparently due largely to the sterility of the pollen. Varieties long propagated seem to have lost the power of seed production more completely than those recently originated, especially if the latter are from a cross with a species nearer the wild condition. This loss of sexual vigor is explained, at least in part, by the continued propagation of our cultivated varieties by the asexual tubers. As the potato blight, so far as is known in nature, carries over from one season to another only through the vegetative mycelium in the tubers, it may be that continued asexual propagation of the fungus in this manner has also resulted in its loss of sexual vigor, especially of the antheridia.

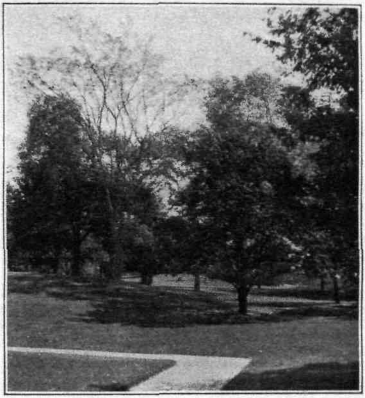


a. Fruit Spot of Apple, p. 723.

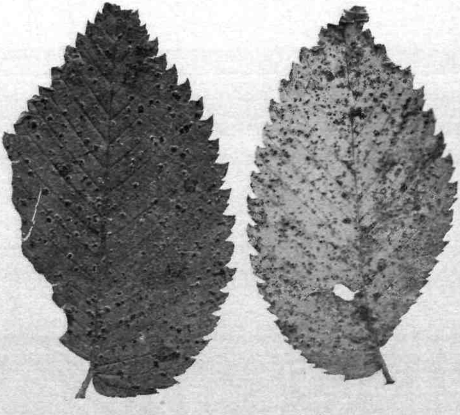


b. Pocket Curl of Azalea, p. 724.

FUNGI OF APPLE AND AZALEA.



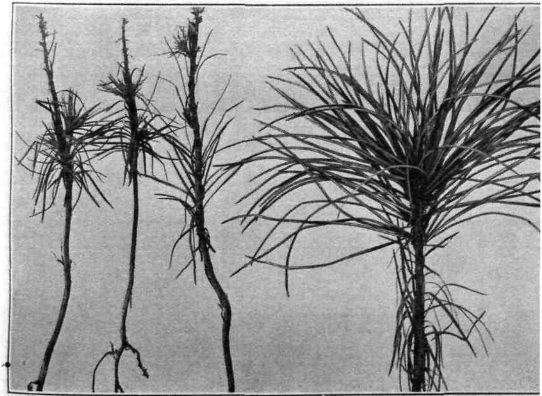
a. Showing an elm defoliated in mid-summer.



b. Appearance of fungus on the leaves.

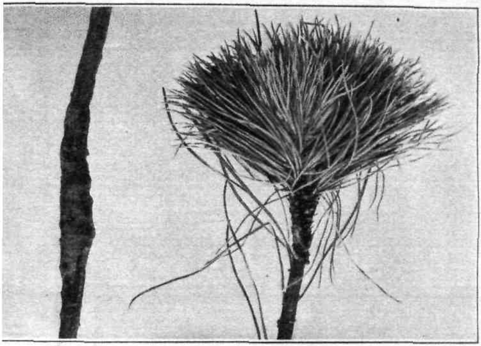
LEAF SPOT OF ELM, p. 717.

a. Drought injury, followed by fungus, p. 729.

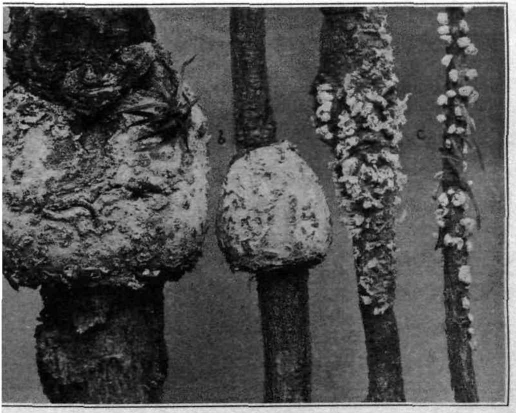


b. Frost injury, p. 730. Healthy.

INJURIES OF WHITE PINE SEEDLINGS.

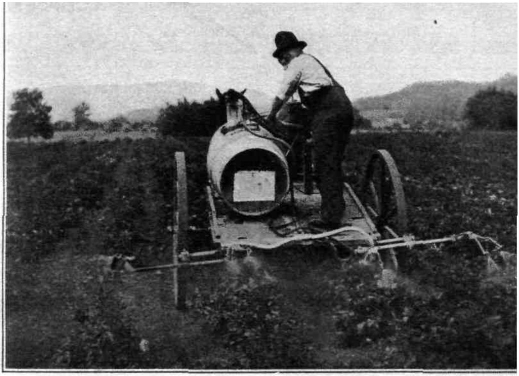


a. Pine-Currant Rust, p. 730.

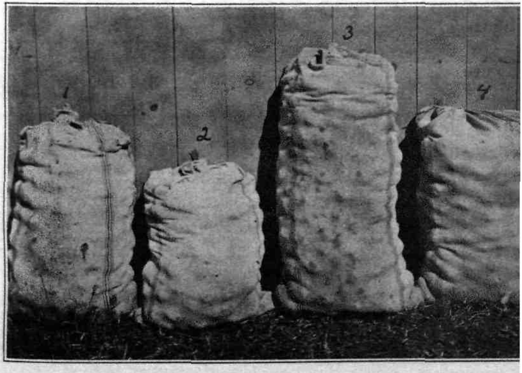


b. Pine-Oak Rust, p. 728. c. Pine-Sweetfern Rust, p. 729.

STEM RUSTS OF PINES.

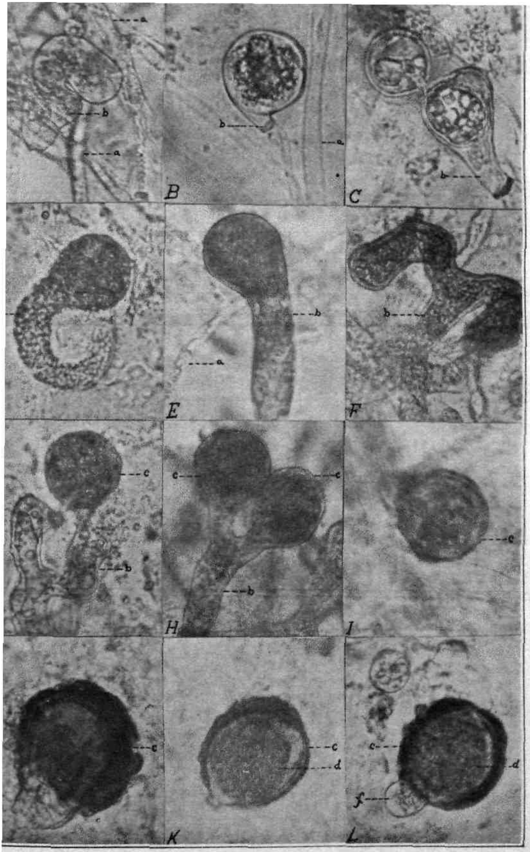


a. Spraying by hand with stationary nozzels.



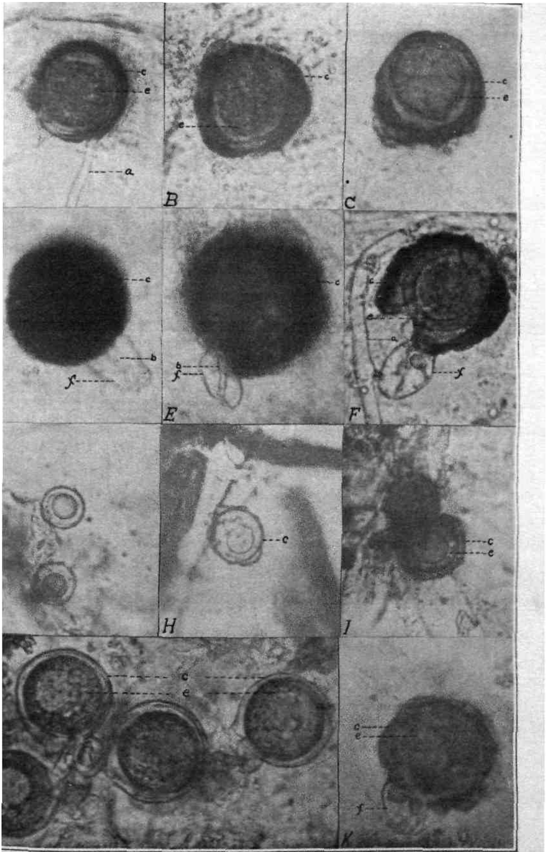
b. Comparative yields from sprayed (1, 3) and unsprayed (2, 4) vines, p. 74

SPRAYING EXPERIMENTS WITH POTATOES.



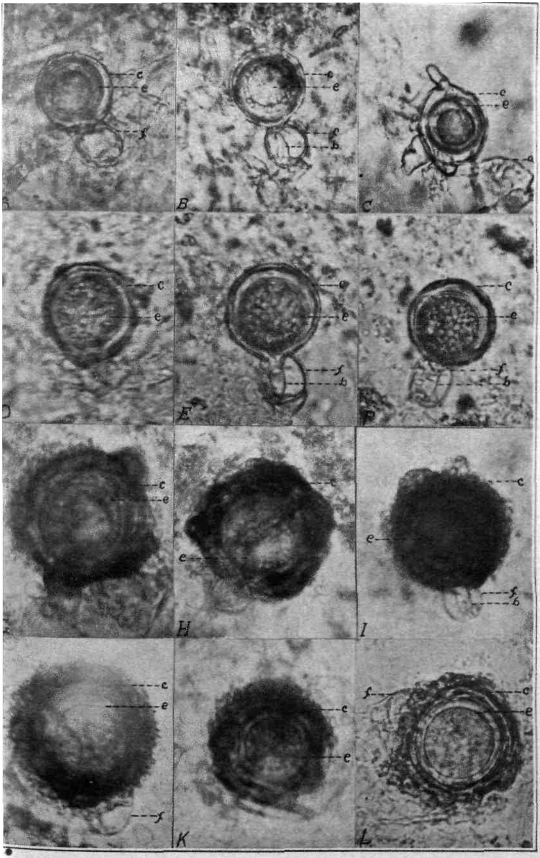
a. mycelium; b. oögonial thread; c. oögonium; d. oösphere; e. oöspore; f. antheridium.

DEVELOPMENT OF OÖGONIA OF PHYTOPHTHORA INFESTANS, p. 769.



F. Mature oögonia, oöspores and antheridia of *P. infestans*, p. 770.
I. Oögonia-like bodies found in blighted leaves and tubers of potatoes, p. 756.
J. Oögonia of *P. cactorum* and K, hybrid of this and *P. infestans*, p. 773.

OÖGONIA, OÖSPORES, ANTHERIDIA OF PHYTOPHTHORA spp. etc.



C, *P. Phaseoli* grown in Lima bean agar. D–F, *P. Phaseoli* grown in same tube of oat agar with *P. infestans*. G–L, Hybrids produced by fertilizing *P. infestans* oögonia with antheridia of *P. Phaseoli*, p. 771.

OÖGONIA, OÖSPORES, ANTHERIDIA OF PHYTOPHTHORA sps.

PART XI.

Forestry Publication No. 6.

REPORT OF THE STATE FORESTER

SAMUEL N. SPRING, M.F.

INTRODUCTION.

There are three important phases of forestry in Connecticut: (1) Protection of woodland and cut-over lands from fire; (2) Application of methods to improve conditions of the forest so as to increase the yield and to grow a better quality of timber; (3) Forest planting of waste lands.

The improvement of forests by thinnings is being demonstrated in the State Forests and in private woodland, under the advice and supervision of the State Forester. Considerable forest planting has been done on open areas in the State Forests. Progress of state forest work and results of special studies of the treatment of woodland will be given in separate publications, or in subsequent reports of the State Forester.

Since 1901 annual plantings of forest trees, chiefly pines, have been made on a tract of land near Rainbow, in the northern part of the town of Windsor, until the Agricultural Station now has 100 acres of experiment forests there. In 1908 the Station purchased a small portion of the Shaker white pine plantation in Enfield and special experiments in thinnings were made in this forest. Further thinnings will be made periodically and results recorded every five years.

A progress report of forest planting at the Rainbow experimental tract and by private owners elsewhere in Connecticut was published in 1908.* Preliminary results of experiments and con-

* Part IV, Report of the Connecticut Agricultural Experiment Station for the year 1907.

clusions will again be reported at the close of the second five-year period ending in 1911.

From the beginning of forestry in this state the persons holding the office of State Forester have recognized the primary importance of protecting forests from fire. Unless they are effectively protected, the development of forestry is seriously hindered. Owners hesitate to make improvement thinnings, plant waste land with trees or practice forestry in any form if fires are likely to ruin the results of their work. Without fire protection such an investment is not an attractive one.

The present State Forester has, therefore, given much time and attention to this subject, in order to supplement previous work of organizing a service to provide adequate forest protection.

This report deals wholly with the subject of forest fires, especially with those of 1910.

Fire Warden Service.

The State Forester is *ex-officio* State Forest Fire Warden. He has supervision of the town and district fire wardens, who are responsible in their respective towns for the protection of woodland from fires. This protective service, established by law in 1905, has become more efficient each year in the control and prevention of forest fires. In 1905 there were only 44 town fire wardens appointed, and the next year there were 119. Up to July 1, 1907, appointments to this position had been made by 140 towns and these town wardens had in turn appointed 270 district fire wardens. The record for 1910 is 160 town fire wardens, with 445 district wardens in 135 of these towns. Of the remainder, five are principal cities, the limits of which are coterminous with the town boundaries. In these cases the chief of the fire department is, according to law, in charge of whatever forest protection is needed. The other three towns have arranged for appointment of a warden (February, 1911).

This, then, practically completes putting the system into operation, but there still remains to be secured a more effective organization of the work in individual towns, arranging fire districts, weeding out men of less efficiency and, of special importance, introducing more effective methods for fighting fires and preventing fires.

The total force in 1910 was 605 fire wardens. Assuming the area of woodland to cover approximately one-half the state, say 1½ million acres, there would be an average of 2,480 acres per man, if the area were uniformly apportioned. The arrangement of districts and the area to be watched by a single warden depends, however, on several things, such as topography of the region, location of the warden's home, etc. District wardens are needed in several towns not now districted and in a few cases an unnecessarily large number were appointed. On the whole, the organization has been brought to a much higher state of development. It is of the greatest importance that selectmen *should reappoint efficient town fire wardens*, not making changes for political reasons, and where new appointments are necessary, a thoroughly capable man should be selected.

Statistics of Forest Fires.

From the beginning of organized work of forest protection in the state, reports of each fire extinguished have been required from the wardens. All the information needed for this purpose can usually be secured by the local warden as soon as he has put out the fire, and his report is required by the State Fire Warden within two weeks afterward. Accurate reporting of fires has been specially emphasized, and more complete records are being secured, although some towns still fail to report.

The following is the printed form used for this purpose.

FORM C. (APRIL 1, 1911)

REPORT OF FOREST FIRE BY TOWN FIRE WARDEN.

(REPORT ONE FIRE ONLY ON THIS SHEET)

To be sent to State Forest Fire Warden, New Haven, Conn., within two weeks after a fire.

Name of town...................... Fire District......................

Date of fire...................... Warden in charge..................

Number of acres burned over { Merchantable timber land.................. / Second growth, not yet merchantable....... / Other land (grass land, bushes, etc.).........

Total acres........

Estimated damage to standing timber and sprouts $......................

Number of buildings burned............Damage $...... Insurance $......

Stacked timber burned..............feet, Value $...... Insurance $......

Piled cordwood burned ....cords, Value $...... Insurance $......

Cause of fire..

....

Underline the methods used in putting out fire. *Bucket pumps; chemical extinguishers; wet brooms and bags; beating; shovels and dirt; back firing.*.....

Number of men employed.......... Bill to town for this fire $............

Additional information ....

....

....

....

....

....

....

Signed.................................

TOWN FIRE WARDEN.

Date.................... P. O. Address................................

If no fires occur during the year return blank saying so on December 31.

These reports are compiled annually and the summaries by towns, counties and for the state make it possible to gain a comprehensive understanding of conditions. The value of summaries has been to some extent lessened by lack of reports from towns having no wardens, or whose wardens fail to realize the full importance of reporting. Until such time as complete reports are secured annually from every town, there will be an apparent increase in number of fires, area burned and losses incurred. In 1909 and 1910 the reports from the towns were nearly com-

plete and probably represent quite closely the actual number of fires. The following table is presented to show, primarily, the development of the fire warden service, and also to give a preliminary understanding of the forest fire problem in Connecticut. Any comparison of these figures by years should take into consideration the number of towns not reporting.

TABLE I.—SUMMARY OF FOREST FIRES.

Year.	Number of wardens.	*Number of towns not reporting.	Number of fires reported.	Area burned. (Acres.)	Average area per fire. (Acres.)	Cost of fighting.	Average cost per fire.
1905	44	126	---	†8,000	---	---------	-----
1906	119	94	125	4,036	32.3	---- ---	-----
1907	140	76	109	4,387	40.2	$1,286.46	$11.80
1908	152	64	283	18,430	65.1	3,646.66	6.88
1909	157	18	339	14,779	43.6	2,755.46	8.13
1910	160	19	834	47,443	56.9	10,024.76	12.02

* Includes five principal cities whose limits are coterminous with those of the town.

† Estimated at end of year.

The development of a new system, such as the forest fire warden service, was necessarily slow. In 1906, 90 per cent. of the towns had appointed wardens, but reports were received from only 60 per cent. This indicates a marked advance in putting the system into operation, but relatively slow progress in efficiency, as represented by reports of work done. (See columns two and three, Table I.) In 1910 95 per cent. of the towns had fire wardens and approximately 90 per cent. of the towns returned reports of fires to the State Fire Warden. The unusually long period of drought in the early spring of 1910 and also in the fall made conditions especially favorable for the occurrence and rapid spread of forest fires. More complete returns from wardens also increase the number of fires recorded and the area burned as compared to that of previous years. Complete reports in 1908 would probably have given 25,000 to 30,000 acres burned as compared to 18,430 in the summary given above for that year. Weather conditions in the dangerous season of 1908 favored the occurrence of forest fires, but there was not so great a degree of drought as was experienced in 1910.

Conditions in 1909 were perhaps midway between those of 1908 and 1910.

The record of 1910 is probably near to the maximum that may be expected any one year and serves to show the necessity of organized effort to prevent and extinguish fires. That the warden service is efficient was shown beyond doubt during the past year. Losses would have been many times greater if fighting fires had been no one's special duty in each town.

In the future a reduction may be expected in the acreage burned; first, through increased efficiency of our wardens and by retaining capable, experienced men in this position; second, by adopting further preventive measures and by using improved methods of fighting fires. Climatic conditions cannot be controlled, but even in periods of extreme drought, as in the present dry years, preventive measures and active work of wardens will keep down the losses greatly if not the total number of fires.

TABLE II.—SUMMARY OF FOREST FIRES, 1909.

(Compiled from reports of 140 towns.)

County.	Causes.				Acres burned.	Estimated damage to standing timber.	Estimated damage to products and buildings.	Cost of fighting.	Mis lan cc
	Total No. fires.	Unknown.	Railroad.	Careless, including brush burning.					
Fairfield	33	18	7	8	1,380	$1,005.00	$ 990.00	$202.79	$ 5.
Hartford	91	39	26	26	5,546	4,922.00	6,415.00	649.97	17.
Litchfield	52	24	16	12	2,233	747.00	771.00	530.99	--
Middlesex	39	11	20	8	495	312.00	1,505.00	154.78	--
New Haven	52	33	4	15	1,786	4,495.00	300.00	320.72	--
New London	11	7	--	4	703	1,515.00	2,125.00	168.95	--
Tolland	28	16	8	4	792	1,750.00	600.00	192.90	3.
Windham	33	12	14	7	1,844	975.00	10.00	334.36	--
Totals	339	160	95	84	14,779	$15,721.00	$12,716.00	$2,555.46	$25.

Of the 1909 fires the cause of nearly one-half (47.2 per cent.) was unknown, 28 per cent. were attributed to the railroad and the rest of the fires was divided among several causes, such as brush burning, carelessness of hunters, fishermen, and others in setting fires. Approximately one per cent. of the woodland area of the state was burned over, with a total loss of $28,437.00. The total cost of the fire warden service for the year, including the State Fire Warden's expenses, was slightly less than $3,000.00.

FOREST FIRES OF 1910.

The following compilation, Table III, gives statistics, by counties, of forest fires of 1910. A detailed record by towns will be found at the end of this report.

TABLE III.—SUMMARY OF FOREST FIRES, 1910.
(Compiled from reports of 141 towns.)

County.	Causes.						Acres burned.	Estimated damage to standing timber.	Estimated damage to forest products and buildings.	Cost of fighting.	Cost of protectio
	Total No. fires.	Unknown.	Railroad.	Careless.	Brush burning.	Incendiary.					
Fairfield	154	86	23	21	19	5	4,481	$11,397.00	$1,894.00	$1,436.77	$ 266.
Hartford	178	78	57	25	17	1	12,795	44,431.00	7,318.00	2,381.13	450.
Litchfield	116	55	43	6	11	1	7,521	25,697.00	7,388.00	1,479.07	94.
Middlesex	75	23	34	11	7	0	4,553	10,995.00	254.50	805.43	340.
New Haven	78	56	9	6	3	4	3,609	8,410.00	1,270.00	790.29	33.
New London	54	40	7	5	2	0	7,966	28,195.00	2,451.00	696.88	4.
Tolland	58	23	25	3	6	1	1,811	4,659.00	103.00	433.38	23.
Windham	121	54	50	7	7	3	4,707	14,816.00	7,343.00	2,001.81	30.
Totals	834	415	248	84	72	15	47,443	$148,600.00	$28,021.50	$10,024.76	$1,243

Weather Conditions and Number of Fires.

Woodland and brush fires are most likely to occur in the spring before vegetation starts and in the fall after the leaves drop from the trees. Disregarding for the moment all other factors, the number and severity of fires depend upon weather conditions during these two seasons. The following table gives for each county the record of fires by months.

TABLE IV.—NUMBER OF FOREST FIRES, 1910.

County.	Total number.	March.	April.	May.	June.	July.	Sept.	Oct.	Nov.
Fairfield	154	41	52	9	--	--	3	42	7
Hartford	178	61	66	4	--	1	--	29	17
Litchfield	116	41	51	7	1	6	--	8	2
Middlesex	75	37	18	3	--	--	--	13	4
New Haven	78	31	29	7	--	--	--	8	3
New London	54	19	18	7	--	--	--	6	4
Tolland	58	24	18	1	1	1	--	11	2
Windham	121	31	53	7	--	1	3	24	2
Totals	834	285	305	45	2	9	6	141	41

March weather in 1910 was abnormally warm and dry. In temperature the average in Connecticut for March, 1909, was 34° Fahr.; for March, 1910, 40.3°, a difference of 6.3° warmer for the latter year. On March 25 it was above 80° in some places in Connecticut. For this month in 1909 there was an average of 4.03 inches rainfall, for 1910 only 1.41 inches rainfall. Precipitation was lower for this month than in years and high winds prevailed. Conditions could scarcely have been worse at this time, when fires are likely to occur.

April was also warmer than usual, although rainfall was more nearly normal. The quantity and distribution through the month, however, were such as to relieve the situation for a few days only. The 285 fires in March occurred in the last half of the month, hence it was proportionately worse than April, when there were 305. In April alone the total number of fires for 1909 was nearly equalled. It was not until May that the conditions were improved. Several fires in dried-out swamps occurred in July which were difficult to fight and could not be controlled for days, since they ate their way beneath the surface. Drought occurred in the last half of September and continued during October. In parts of Connecticut it was reported as the worst in fifty years and many streams, springs, ponds and wells went dry, or were unusually low. Here, again, the effect is apparent, there being a total of 141 forest fires in October.

Such weather conditions, while extraordinary, occur at irregular intervals and emphasize the necessity of well-organized fire warden service, prepared especially to meet these unusual conditions, as well as for the control and prevention of such forest fires as may occur during years which are more nearly normal.

Area Burned Over.

In case of prolonged drought and adverse weather conditions, as in 1910, fires are not only likely to be more numerous, but burn with greater rapidity. If they gain headway before fighting can be begun, or escape from control, large areas are sure to be burned. In very dry seasons it is much more difficult to gain control of a fire and extinguish it before it has covered considerable ground. This is due to the fact that logs, brush, dead grass and other fuel for the flames is so thoroughly dry

that sparks carried by the wind readily set new fires, unless the whole line can be effectively watched.

A total of 834 fires in 1910 burned 47,400 acres, or an average of 57.4 acres per fire. This average is less than 1908 and more than the other years recorded in Table I.

A classification of figures of the acreage burned by forest fires of 1910 shows the effective work of the wardens and is given in the following table.

TABLE V.—NUMBER AND AREA OF FIRES.

	All fires.	Fires less than 100 acres in extent.	Fires 100 acres or more in extent.
Number	834	707	127
Total acreage burned	47,400	11,670	36,230
Average acreage per fire	57.4	16.5	286.8

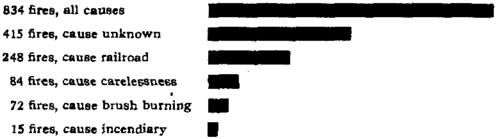
Of the 834 fires, 707, or 85 per cent., were less than 100 acres in extent. The average per fire was 16½ acres and the total area burned was 11,670 acres. This shows that in the majority of cases the fires were fought promptly and extinguished before they covered much ground. The remaining 127 fires, or 15 per cent. of the total number, averaged 286.8 acres per fire and burned over three times as much ground as the 707 fires. Most of these larger fires occurred in the spring. Fast Day, March 25, holds the record as the worst day for fires in many years. Sixty-three fires started and burned more than 10,000 acres. Twenty of these fires burned more than 100 acres each. Three were the largest fires of the year, one in Glastonbury, 3,500 acres, another in Southington covering 2,000 acres, and the third in New Milford 1,500 acres. Losses from these three aggregated $33,000. Most of the fires on Fast Day originated from careless burning of brush or the thoughtless setting of fires by people in the woods on this holiday. The unusual heat and windiness of the day and great dryness of the surface caused rapid spreading of the flames.

During the year there were but eleven fires which exceeded 500 acres in size.

Causes and Damage.

The following diagram shows the number of forest fires classified according to causes.

NUMBER AND CAUSES FOREST FIRES, 1910.



It is practically impossible for wardens to ascertain the causes of all fires and in cases of any uncertainty they almost invariably report the cause as unknown. At first glance at the diagram it is natural to conclude that the fires of unknown cause may be classified in the same relative proportion, according to cause, as those of known source. This would not necessarily be correct. The railroad heads the list, according to the diagram given above, and if causes of all fires were known it might still be at the top, or second compared with all the others together, as a source of forest fires. However, there are several facts easily ascertained that lead to attributing the source of a fire to the railroad; for example, a fire near the railroad, starting immediately after the passing of a heavy freight or passenger train on an up grade, the line of the fire extending out directly from a point on the right of way, etc. Thus it is probable that nearly all railroad fires were reported as such. No such plain facts point to the source of other fires, except perhaps those originating from burning out fence rows and by burning brush piles near woodland. The inference is that the majority of fires whose cause is stated as unknown are not chargeable to the railroad. They are more than likely due to the carelessness of hunters, fishermen, smokers, and to persons setting fire to clean up cut-over land or brushy pasture. Not a few of these fires are started by lighted matches, cigar or cigarette butts thrown down by travelers on the highway, or persons passing through woodland.

Compilation of the causes of forest fires and a study of conditions in the state which favor the occurrence of fires are of great value in determining measures of control and prevention. A statement of the progress along these lines and measures

recently put into effect will be found on page 786, under "Measures of Control and Prevention of Forest Fires."

In order to ascertain the relative losses according to cause, the table given below was compiled from data of forest fires furnished by wardens in 1910.

TABLE VI.—LOSSES IN RELATION TO CAUSE.

Cause.	Number.	Per cent.	Acres burned.	Per cent.	Damage to Timber.	Per cent.
Unknown	415	50	28,000	59	$94,000	63
Railroad	248	30	10,000	21	33,000	22
Carelessness	84	10	2,400	5	10,200	7
Brush Burning	72	8	4,200	9	9,900	7
Incendiary	15	2	2,800	6	1,500	1
Totals	834	100	47,400	100	$148,600	100

From this table it will be seen that the railroads, for example, are responsible for 30 per cent. of all fires in Connecticut in 1910, 21 per cent. of all the area burned, and 22 per cent. of the losses incurred.

It is apparent that we have relatively little loss from fires deliberately set with criminal intent and that our chief sources of danger are the railroads and the failure of the majority of our citizens to realize the importance of the utmost care during the dangerous spring and fall seasons.

Cost of Fighting Fires.

The total cost of extinguishing 834 fires in 1910 was $10,024.-76, or an average cost of $12.02 per fire. The cost of posting warning notices, issuing permits required under Chap. 128, Sec. 4, Public Acts of 1909, etc., was $1,243.39, making a total of $11,268.15. According to the law one-half of the expense is borne by the towns concerned, one-quarter by the county, and one-quarter by the state. The amount spent by the State Forest Fire Warden for the year was $695.91, of which $130.00 were spent to replace supplies lost in a fire on January 10, 1910, which destroyed the building where the State Forester's office was located. Expenses of the office comprise clerk and steno-

grapher's services, postage and stationery, printing of laws and instructions, report and permit forms, cloth warning notices, etc., and the traveling expenses of the State Forester in performing his duties under the law as State Forest Fire Warden. The grand total of expense for 1910 was $11,964.06, which in all probability is the maximum for any one year. This expenditure represents a little less than one cent an acre for protection of the woodland of the state. In preceding years, during which there was greater rainfall and less adverse conditions than in 1910, the cost of protection was approximately 1/3 to 1/2 of a cent per acre. The expenditure of less than one cent per acre per year is a very reasonable amount for protection in consideration of the value of our standing timber and the prospective values in our young growth that is not yet merchantable and which suffers worst if it is burned over.

Measures of Control and Prevention of Forest Fires.

A reduction in the number of fires, the area burned and the amount of damage can be secured through efforts along several lines at the same time.

Local Organization:

In putting the fire warden system into operation, the chief effort at the outset has been to have reliable men appointed as wardens and to secure prompt, energetic, honest work in extinguishing every woodland fire which starts. A good measure of success has been attained in this respect, as indicated by the statistics for 1910. In some few towns the organization of the service and the fighting of fires has been of the highest grade. In such towns the fire warden has intelligently divided the town into fire districts under the charge of capable men, has thoroughly posted the town with cloth warning notices, has held a meeting of the wardens to plan systematic work and has adopted improved methods for fighting fires. Such organization of work within towns is essential to successful protection of woodland from fires and their prompt extinguishment.

Coöperation between Towns:

Only in rare instances have wardens in any towns arranged special coöperation with wardens of adjacent towns. Coöper-

ation between towns is highly important and is easily carried out by use of the telephone. The arrangement in many cases need be only the mutual understanding between wardens and others on either side of the town line that if fires are seen they will be reported by telephone at once to the nearest warden of the town concerned. A plan is now being arranged to make a trial of this in the towns of Union, Woodstock, Ashford, Eastford and Stafford, by the establishment of a lookout. This lookout will be located on Ochepetuck Mountain, locally called Bald Hill, in the town of Union. This is to be a central point for the receipt and sending of messages by telephone concerning fires.

The person living on this hill will keep a lookout for fires each day during the dry season of 1911, will ascertain the nature and definite location of a fire by means of the telephone and be guided by a large map on which are entered the location, name and telephone number of coöperating parties in the five towns. The lookout, after receiving definite information, will notify the nearest warden and give instructions. Such a system, worked out in detail, will save time and money for the towns concerned, causing fires to be quickly extinguished.

Fire Fighting.

In the actual work of fire fighting much advantage is gained in cases where the fire warden acts as foreman of the fighters and directs the work, going from point to point. In one town the warden carries a signal whistle and when help is needed immediately on the fire at another point he summons a part of his force by whistle signals. Each town fire warden has to study conditions in his town and determine the most effective means of extinguishing fires and the sources from which men can be secured quickly to fight fires in a given locality.

In several towns coöperation has been secured with manufacturing companies and large owners, by which in case of a forest fire a telephone message to them will bring a gang of laborers at once to assist the warden in extinguishing it. In some instances the outside foreman of a company has been appointed a district warden, and has permission to use the company's men as required at forest fires.

The common methods of fighting fires have been beating with brush or wet bags, smothering with dirt by use of shovel and

hoe, and backfiring. Small attention has been given by towns to the furnishing of wardens with a good equipment and to testing apparatus useful for extinguishing woodland fires. Massachusetts has emphasized this matter greatly and many towns have fire wagons, well equipped with chemical extinguishers, tools, etc. Some Connecticut towns have provided wardens with small chemical extinguishers and with ordinary tools for fighting fires. In one case the question of procuring a wagon specially constructed and similar to Massachusetts wagons is under consideration.

At Simsbury the bucket spray pump has been adopted for use in fighting fires and has proved very effective. Every warden is supplied with one. In its use for fire fighting the pump is attached to a galvanized iron pail, the top of which is covered with burlap. A fire nozzle is substituted for the usual spray nozzle. The cover of burlap permits the use of water from any stream or swamp without clogging the pump. With a fire nozzle a stream may be thrown with decided force.

Wherever water is available or can advantageously be hauled this method surpasses all others. It is useful also in controlling a back fire. In practice the man with the pump is followed by two or three men with hoes and shovels, who complete the extinguishing and throw back into the burned area inflammable material that lies across the line of the fire. The other laborers are chiefly engaged in bringing water. One bucketfull will put out 150 to 200 feet of fire. Fire on brush land or rocky land, ordinarily very difficult to extinguish except by backfire, is effectively handled with the bucket pump. So valuable has the method proven that the Simsbury warden and the State Fire Warden have designed the two-man pump shown in Plate XLI. The water capacity of the tank is eight gallons. It may be equipped with a larger tank if desirable. It is designed to be carried by two men, the one in front holding one handle and directing the stream, the one behind holding the other handle and pumping. Tests of this model have proven satisfactory.

Every town should take up the subject of equipment for wardens and purchase at once a supply of the ordinary tools and some apparatus for a test of the best methods to meet local conditions. A small amount thus spent means a large saving in

Effective organization of the fire warden service, hearty coöperation between landowners and wardens, watchfulness followed by prompt action when fires are seen, and use of the best methods must tend to lessen the area burned annually. Back of all this are the causes of fires. All fires cannot be prevented, but a very large proportion need never occur at all.

Prevention of Railroad Fires.

Railroad fires start chiefly from locomotive sparks, occasionally from fire escaping from piles of old ties which are being burned by section gangs. The proper condition of the engines is important. Railroad officials state that all engines are provided with spark arresters, and railroad orders are said to be strict in reference to maintaining the screens in good condition. No spark arrester thus far invented, however, prevents emission of all sparks, but the number is greatly reduced by the use of an arrester, and by keeping it in repair.

The condition of the right of way is of primary importance. The practice of the railroads has been to cut vegetation in the summer just before the weeds begin to seed. Subsequent clearing of inflammable material later in the year has not been systematically done each year. Clearing by burning in the late fall and winter was more effectively carried out in December, 1910, and January, 1911, than in previous years. It should be made the practice to burn dry grass on the right of way annually wherever the railroads pass through woodland, brushland or grassland adjoining woodland. This is especially important at points where the grade of the road is heavy and sharp curves occur. If the right of way is in proper condition, sparks dropping on it die out and fire will not be communicated to adjoining land by this means. Many fires, however, start from sparks falling outside the right of way in leaves, dry grass or other inflammable material. Clearing such materials by burning a strip a hundred feet from the edge of the location of the right of way will greatly lessen the danger of fires from this source. In case of woodland, little injury to the trees results if leaves and twigs are raked away from the base of the trunks before the burning is begun on the strip to be cleared. A bucket pump and water should be kept on hand, to control the fire at any moment and prevent its escape.

Massachusetts and New Jersey laws provide that the railroad shall carry out, at its own expense, protective clearing on private land outside the right of way without liability of trespass. Such work is a great measure of prevention of railroad fires, insures protection to the abutting property owners and lessens the amount of damages for which the railroad is annually liable. Such a preventive measure should be enacted into law in Connecticut. Experiments along this line have been tried on the State Forest at Simsbury. Where the strip has been cleared and burned, no fires have spread on that side from the railroad which passes through the state land. Planted forest is thriving on this land, which has previously been burned over so frequently by fires started by passing trains as to be considered by the owners as worthless for any purpose. On the South side of the railroad, where no plantations had been set and no protective strip established, a fire set by an engine spark occurred in 1910 which killed valuable seed trees. Even with the protection afforded by work as indicated above, fires may start from railroad causes if the season be very dry and windy. Under such conditions only one way remains to prevent such fires, or reduce their number, and that is to establish a patrol. Such a patrol was put into operation in Simsbury along a dangerous stretch of the railroad in 1908. It was maintained for six weeks in early spring and prevented all fire damage. Thirty-five fires were seen and extinguished. The cost was borne equally by the town of Simsbury and the C. N. E. railroad. Such a patrol at danger points on the railroad is necessary in prolonged periods of spring or fall drought. Any work along this line by the track-walker or the section gangs has either been wholly lacking or ineffective. Nearly always these fires occur immediately after the passing of certain regular trains on an up grade. Undoubtedly the following up of these trains along the most dangerous stretches where the road passes through woodland and up grade would prevent a very large number of fires. At the present time there are hundreds of acres of unimproved land along the railroad in this state which have been rendered valueless and on which profitable forest cannot be maintained because of railroad fires.

Enforcement of Forest Laws.

Public opinion in regard to forest fires has changed greatly in the past decade. This is reflected in legislation and in the

enforcement of the laws. Both legislation and earnest efforts to have the law properly enforced are traceable to citizens who have foreseen the necessity of developing our forest lands just as our crops and orchards have been improved by intensive scientific methods. To bring about this development, adequate protection from fire was seen to be essential. The Connecticut Forestry Association, a body of representative Connecticut citizens, has been greatly influential in securing progressive legislation to further the prevention and control of forest fires. The Assembly of 1909 passed the so-called "brush permit law," the full text of which is as follows:

PUBLIC ACTS OF 1909, CHAPTER 128.

SEC. 3. Every person who shall kindle or authorize another to kindle, at any time, a fire in the open air, which fire occasions an injury to another, shall be fined not more than two hundred dollars, or imprisoned not more than six months, or both.

SEC. 4. Every person, except as hereinafter provided, who shall kindle or authorize another to kindle a fire in the open air, outside the limits of any city, borough, or land controlled by any railroad company, for the purpose of burning bushes, weeds, grass, or rubbish of any kind, between the fifteenth day of March and the first day of June, and the fifteenth day of September and the fifteenth day of November, in any year, without first obtaining from the fire warden of the district written permission stating when and where such fire may be kindled, shall be fined not more than two hundred dollars, or imprisoned not more than six months, or both.

SEC. 5. Whenever the state fire warden shall deem that the public safety of any town of this state does not require the protection provided by section four of this act, and the town so votes, he may cause the town fire warden of any such town to post notices to that effect in conspicuous places, not less than five in each town, or two in each fire district. Whenever such notices have been posted, each town so affected shall be exempt from the operation of the provisions of section four of this act until the fifteenth day of March of the next succeeding year.

In 1919 only one town applied for exemption, and this was not given, since action by the town was not taken until about two weeks before the fall season ended and there was insufficient time for the State Fire Warden to make the necessary investigation before taking action.

At the outset, before the law was fully understood, it was criticised severely, but later received the approval and hearty commendation of nearly everyone. It was directed toward lessening the number of fires due to carelessness in burning

brush, rubbish, etc., on land adjoining woodland. A permit in itself in no way prevents a woodland fire. However, if a person applies for and receives a permit he accepts a certain responsibility in the matter, can be warned to be careful, can be required to adopt measures to prevent the fire spreading, and so on. In time of prolonged drought fire wardens have withheld issuing permits until abundant rainfall occurred.

This law was enforced in a very reasonable way, in the spirit of educating people to use much greater care and with the desire not to make it a hardship in any way to secure necessary permission. Few complaints were heard as to its enforcement, and none in those towns having an efficient town fire warden and a sufficient number of district wardens, to any of whom citizens could apply for a permit.

The law was a little too broad, since its provision covered cases of fires in village streets, gardens, etc., not adjoining woodland. For this reason an amendment was proposed and submitted to the 1911 Assembly as follows:

Provided, however, that such permits shall not be necessary for kindling a fire in a ploughed field, garden or public highway at a distance of not less than two hundred feet from any woodland, brushland, or field containing dry grass or other inflammable material.

In cases of malicious act or criminal carelessness in kindling fires it is necessary to prosecute in order to give an object lesson.

The following is a list of cases prosecuted in 1910:

PROSECUTIONS UNDER FOREST LAWS.

Name of town.	Number of persons prosecuted.	Laws violated.	Results.
Bristol	1	Chap. 128, §3,* Pub. Acts 1909; " 43, §1221,† " " 1907	10 days in jail and costs ($13.90).
Huntington	1	" 128, §4,* " " 1909	Costs ($5.87). Fine remitted.
	1	" 128, §4, " " 1909	$6.00 and costs, amounting to $20.42.
Milford	1	------	Costs ($14.24).
Montville	1	" 128, §4, " " 1909	Nolled.
Norfolk	1	" 128, §4, " " 1909	$1.00 and costs.
Southington	1	" 128, §3, " " 1909	$5.00 and costs ($11.21).
	1	" 128, §4, " " 1909	$25.00 and costs ($8.96).
Stamford	1	" 128, §4, " " 1909	Not convicted.
	1	" 128, §4, " " 1909	$10.00 and costs.
Stratford	1	" 128, §4, " " 1909	$7.00 and costs, amounting to $22.71.
Wolcott	1	" 128, §4, " " 1909	$1.00 and costs.
Woodstock	2	" 128, §4, " " 1909	$1.00 and costs in each case.

* Chapter 128, sections 3 and 4, will be found on p. 791 of this report.
† Forbids kindling fire in woodland without first removing combustible materials for 20 feet surrounding; fire must be extinguished before leaving, or safely covered.

These prosecutions show clearly the growth of public sentiment, and the determination to enforce the law and by that and other means reduce the losses by forest fires. There is, however, a tendency on the part of people whose forest has been burned over by some one through criminal carelessness to withhold testimony or reluctantly bear witness against the party, perhaps a neighbor, who is charged with the crime. Coöperation and assistance of the prosecuting officer along these lines is extremely essential for the public good.

Economic Results of Forest Fires.

People in general deplore losses by forest fires; few realize the economic results. Light surface fires repeatedly burning over woodland mean steady deterioration of the forest, resulting finally in a worthless stand. Trees become weakened through fire injury and are subject to attacks by insects and fungi. This

has been found especially true in observing the increase in damage from the chestnut bark disease. Fire damage is great in young stands of timber not yet merchantable and in young sprout growth following cutting. Our future supplies of forest products depend especially upon the protection and care of cut-over lands.

In the case of very hot fires, all the trees are killed. Sprouting from the stumps of broadleaf deciduous trees in burned land may be lacking or weak. The dead stems, unless removed, form a hindrance to renewal of the stand and at the best the next crop of trees will be inferior. An area annually destroyed such as was burned in 1910, is equal to cutting over the whole woodland of Connecticut in fifty or sixty years. The present supply cannot equal future demands under our present methods of handling woodland. It is, therefore, of the greatest importance that losses by fire be reduced to the minimum through intelligent work of an organized fire warden service, enforcement of the laws, special measures of prevention, and the coöperation of every citizen in the state.

FOREST FIRES OF 1910 IN DETAIL.

Name of Town.	No. of Fires.	Causes.					Acres Burned.	Estimated Damage.	Cost of Fighting.
		Unknown.	Railroad.	Carelessness.	Burning Brush.	Incendiary.			
Fairfield County.									
Bethel	8	5	1	----	1	1	190	$ 231.	$ 94.47
Bridgeport	----	No	Re	port	----	----	------	--------	--------
Brookfield	5	----	3	1	1	----	170	85.	7.60
Danbury	10	8	----	1	1	----	377	1030.	139.90
Darien	11	7	----	2	----	2	81	--------	76.35
Easton	7	4	----	1	2	----	195	435.	18.80
Fairfield	1	1	----	----	----	----	100	--------	27.50
Greenwich	0	----	----	----	----	----	------	--------	--------
Huntington	15	11	2	----	2	----	835	3398.	195.20
Monroe	8	2	5	1	----	----	67	125.	16.10
New Canaan	11	7	----	----	4	----	40	67.	16.56
New Fairfield	3	2	----	1	----	----	23	--------	55.43
Newtown	4	2	2	----	----	----	120	435.	--------
Norwalk	4	1	----	1	2	----	68	50.	19.40
Redding	5	4	----	----	----	1	435	630.	61.10
Ridgefield	2	2	----	----	----	----	60	300.	29.40
Sherman	2	1	----	----	1	----	110	1005.	101.35
Stamford	18	10	----	4	4	----	860	3253.	420.66
Stratford	9	3	----	4	1	1	94	910.	44.10
Trumbull	15	13	1	1	----	----	233	385.	30.15
Weston	0	----	----	----	----	----	------	--------	--------
Westport	1	1	----	----	----	----	50	25.	8.00
Wilton	15	2	9	4	----	----	373	907.	74.70
Totals	154	86	22	21	10	5	4481	$13201.	$1436.77

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of *Fires.*	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
Hartford County.									
Avon	5	2	2	1			162	$ 90.	$ 43.93
Berlin	5	2		3			407	1758.	138.65
Bloomfield		No	Re	port					
Bristol	25	7	8	8	2		402	3875.	190.93
Burlington	0								
Canton	3		3				70	300.	24.23
East Granby	2	1		1			140	100.	21.45
East Hartford	3	3					287		50.20
East Windsor	17	2	15				558	12757.	59.30
Enfield	19	11	4	2	2		445	2630.	265.57
Farmington	14	7	7				311	685.	154.51
Glastonbury	15	12		1	2		4348	6995.	518.76
Granby	1			1			6	300.	
Hartford		No	Re	port					
Hartland	0								
Manchester	11	9	1		1		336	2745.	104.45
Marlborough	1	1					150	150.	57.00
New Britain	0								
Newington	0								
Plainville	5		2	2	1		952	1350.	61.05
Rocky Hill	2	2					70	150.	9.75
Simsbury	18	2	10	4	2		442	594.	262.56
Southington	14	7		2	4	1	2370	12095.	216.59
South Windsor	10	2	5		3		1140	4510.	124.15
Suffield	0								
West Hartford	1	1					1		1.20
Wethersfield		No	Re	port					
Windsor		No	Re	port					
Windsor Locks	7	7					198	665.	76.85
Totals	178	78	57	25	17	1	12795	$51749.	$2381.13

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damage.	Cost of Fighting
Litchfield County.									
Barkhamsted	2	----	2	----	----	----	222	$ 2000.	$ 10.00
Bethlehem	----	No	Re	port	----	----	----	----	----
Bridgewater	2	2	----	---	----	----	42	43.	17.40
Canaan	----	No	Re	port	----	----	----	----	----
Colebrook	1	----	----	1	----	----	----	----	3.65
Cornwall	8	1	6	----	1	----	471	715.	46.32
Goshen	1	----	----	--	1	----	150	340.	10.50
Harwinton	4	1	----	1	2	----	145	898.	59.75
Kent	1	1	----	----	----	----	25	50.	24.50
Litchfield	7	3	4	----	----	----	571	50.	157.73
Morris	5	----	5	----	----	----	180	902.	60.77
New Hartford	4	1	2	1	----	----	142	2140.	29.05
New Milford	2	1	1	----	----	----	1502	9525.	101.60
Norfolk	3	----	1	----	2	----	182	300.	69.30
North Canaan	7	----	7	----	----	----	189	750.	23.50
Plymouth	12	7	3	2	----	----	570	1655.	74.88
Roxbury	5	1	3	----	1	----	891	3779.	79.75
Salisbury	0	----	----	----	----	----	----	----	----
Sharon	2	2	----	----	----	----	275	2830.	53.10
Thomaston	7	6	1	--	----	----	151	6.	105.20
Torrington	10	10	----	----	----	----	568	2870.	254.90
Warren	1	1	----	----	----	----	2	----	2.90
Washington	6	1	5	----	----	----	389	324.	78.92
Watertown	5	3	----	----	1	1	599	3025.	48.90
Winchester	15	10	3	----	2	----	176	798.	116.75
Woodbury	6	4	----	1	1	----	72	85.	49.70
Totals	116	55	43	6	11	1	7521	$33085.	$1479.07

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Carelessness.	Burning Brush.	Incendiary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
Middlesex County.									
Chatham	3	....	....	2	1	....	143	$ 211.	$ 41.05
Chester	3	3	....	....	....	....	540	1285.	31.30
Clinton	3	1	....	1	1	....	1240	2520.	58.68
Cromwell	2	2	....	....	....	....	150	100.	29.70
Durham	3	2	....	1	....	....	24	525.	14.15
East Haddam	1	1	....	....	....	....	300	100.	38.45
Essex	14	....	10	2	2	....	27	200.	35.88
Haddam	3	2	1	....	....	....	950	3100.	88.15
Killingworth	2	2	....	....	....	....	700	1200.	105.55
Middlefield	...	No	Re	port	....	....	......	....	....
Middletown	21	5	9	4	3	....	271	1548.	303.60
Old Saybrook	15	2	13	....	....	....	89	135.	19.19
Portland	2	1	....	1	....	....	100	200.	27.90
Saybrook	....	No	Re	port	....	....	......	....	....
Westbrook	3	2	1	....	....	....	19	125.	11.83
Totals	75	23	34	11	7	0	4553	$11249.	$805.43

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Carelessness.	Burning Brush.	Incendiary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
New Haven County.									
Ansonia	1			1			100	$ 150.	$ 19.65
Beacon Falls	2		2				55	200.	135.25
Bethany	3	2		1			76	245.	36.25
Branford	14	11		3			211	180.	131.59
Cheshire	9	7	2				164	1090.	51.65
Derby	4	3				1	29	10.	7.00
East Haven		No	Re	port					
Guilford	4	3		1			24	145.	32.10
Hamden	4	3			1		535	650.	63.55
Madison		No	Re	port					
Meriden	1	1					20	10.	8.00
Middlebury	1	1					10	10.	
Milford		No	Re	port					
Naugatuck	12	8			1	3	342	443.	99.75
New Haven		No	Re	port					
North Branford	0								
North Haven	0								
Orange	3	3					52	90.	7.25
Oxford	7	5	2				660	2067.	113.50
Prospect	3	1	1		1		230	265.	11.68
Seymour	1	1					4	10.	12.80
Southbury	2		2				600	600.	2.00
Wallingford	1	1					5	5.	2.25
Waterbury		No	Re	port					
Wolcott	5	5					472	3510.	52.57
Woodbridge	1	1					20		3.45
Totals	78	56	9	6	3	4	3609	$9680.	$790.29

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Carelessness.	Burning Brush.	Incendiary.	Acres Burned.	Estimated Damage.	Cost of Fighting.
New London County.									
Bozrah		No	Re	port					
Colchester	2	2					175	$ 350.	$ 13.70
East Lyme	1	1					100	50.	17.60
Franklin	3	3					218	455.	19.20
Griswold	4	4					1890	10725.	111.00
Groton	7	5		2			985	3375.	120.50
Lebanon	2	1	1				104	110.	34.15
Ledyard	7	6			1		823	2125.	86.70
Lisbon	8	3	5				300	600.	46.01
Lyme	2	1		1			21	10.	12.42
Montville	4	3		1			60	30.	21.85
New London		No	Re	port					
North Stonington	1	1					1000	5000.	7.70
Norwich	3	3					1230	2680.	28.30
Old Lyme	4	2	1		1		300	1076.	63.55
Preston	0								
Salem	0								
Sprague		No	Re	port					
Stonington	2	1		1			65	100.	
Voluntown	2	2					625	3400.	114.20
Waterford	2	2					70	560.	
Totals	54	40	7	5	2	0	7966	$30646.	$696.88

FOREST FIRES OF 1910 IN DETAIL—*Continued.*

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damages.	Cost of Fighting.
Tolland County.									
Andover	2	----	----	----	2	----	175	$ 90.	$ 3.75
Bolton	21	4	13	3	1	----	287	1486.	25.60
Columbia	2	1	----	----	1	----	265	25.	9.25
Coventry	2	1	1	----	----	----	157	1035.	34.45
Ellington	1	----	----	----	1	----	15	----	2.00
Hebron	3	1	2	----	----	----	256	152.	3.40
Mansfield	5	2	2	----	----	1	268	690.	16.47
Somers	1	1	----	----	----	----	25	----	7.55
Stafford	----	No	Re	port	----	----	----	----	----
Tolland	----	No	Re	port	----	----	----	----	----
Union	2	2	----	----	----	----	45	187.	126.00
Vernon	18	11	7	----	----	----	316	1097.	204.91
Willington	1	----	----	----	1	----	2	----	----
Totals	58	23	25	3	6	1	1811	$4762.	$433.38

Name of Town.	No. of Fires.	Causes. Unknown.	Railroad.	Careless-ness.	Burning Brush.	Incen-diary.	Acres Burned.	Estimated Damages.	Cost of Fighting.
Windham County.									
Ashford	5	3	----	2	----	----	206	$1700.	$ 59.45
Brooklyn	2	2	----	----	----	----	----	----	14.60
Canterbury	3	1	2	----	----	----	184	600.	13.40
Chaplin	1	1	----	----	----	----	25	----	14.00
Eastford	1	1	----	----	----	----	100	----	7.45
Hampton	1	----	1	----	----	----	8	50.	----
Killingly	7	4	3	----	----	----	134	450.	176.12
Plainfield	10	2	3	2	2	1	1005	2245.	106.79
Pomfret	4	1	3	----	----	----	110	1400.	85.81
Putnam	16	4	11	1	----	----	157	3330.	163.23
Scotland	1	----	----	----	1	----	10	10.	6.50
Sterling	13	8	5	----	----	----	1247	4085.	164.52
Thompson	37	23	12	----	----	2	704	5224.	820.16
Windham	14	1	10	1	2	----	318	1065.	130.98
Woodstock	6	3	----	1	2	----	499	2000.	238.80
Totals	121	54	50	7	7	3	4707	$22159.	$2001.81

TOWN FIRE WARDENS 1911.

Town	Name of Warden	Address
Andover	Edwin H. Cook	Andover
*Ansonia		
Ashford	Edward F. Bassett	Warrenville
Avon	F. J. Distin	Unionville
Barkhamsted	Harold P. Birden	Barkhamsted
Beacon Falls	Milton Carrington	Seymour
Berlin	Wm. J. Ritchie	Kensington
Bethany	Arthur H. Doolittle	Bethany, R. F. D. No. 3
Bethel	Henry F. Kyle	Bethel
Bethlehem	Albert E. Johnson	Bethlehem
Bloomfield	Melville H. Barnard	Bloomfield
Bolton	Waldo E. Rice	Bolton Notch
Bozrah	John H. Miner	Yantic, R. F. D. No. 1
Branford	Chester W. Prann	Branford
*Bridgeport		
Bridgewater	Reuben J. Keeler	Bridgewater
Bristol	George A. Rowe	Bristol
Brookfield	Eugene Elwood	Danbury, R. F. D. No. 18
Brooklyn	Henry M. Evans	Brooklyn
Burlington	Frank A. Barnes	Collinsville, R. F. D. No. 2
Canaan	M. C. Dean	Falls Village
Canterbury	A. Hale Bennett	South Canterbury
Canton	Burton N. Bristol	Collinsville
Chaplin	William J. Lee	Chaplin
Chatham	F. J. Dunham	East Hampton
Cheshire	Alfred S. Bennett	Cheshire
Chester	L. A. Kelsey	Chester
Clinton	Holcomb N. Jones	Clinton
Colchester	H. P. Buell	Colchester
Colebrook	Horace W. White	Colebrook
Columbia	George H. Champlin	Leonard's Bridge
Cornwall	Henry J. Bouteiller	Litchfield, R. F. D., E. Cornwall
Coventry	Geo. H. Robertson	South Coventry
Cromwell	John W. Gardner	Cromwell
Danbury	Morris Meyers	Danbury
Darien	Abel Dance	Darien
Derby	Geo. L. Curtis	Derby
Durham	James P. Hull	Durham Center
Eastford	Chas. E. Buell	North Ashford
East Granby	Frank H. Dibble	East Granby
East Haddam	W. S. Hungerford	East Haddam
East Hartford	John T. O'Neill	Glastonbury, R. F. D. No. 2
East Haven	Irving Hoxsey	East Haven
East Lyme	William R. Proctor	Niantic
Easton	Chas. G. Keller	Long Hill, R. F. D. No. 9
East Windsor	John J. O'Melia	Broad Brook
Ellington	A. U. Charter	Rockville, R. F. D. No. 4
Enfield	William Wilson	Hazardville
Essex	Everett W. Doane	Essex
Fairfield	John C. Lobdell	Fairfield, R. F. D. No. 9
Farmington	F. A. Cadwell	Farmington
Franklin	Frank I. Date	North Franklin
Glastonbury	Jefferson J. Weir	Glastonbury, R. F. D. No. 1
Goshen	E. H. Johnson	Torrington, Star Route
Granby	F. E. Rice	Granby
Greenwich	John Hvolbeck	Port Chester, N. Y., R. F. D.

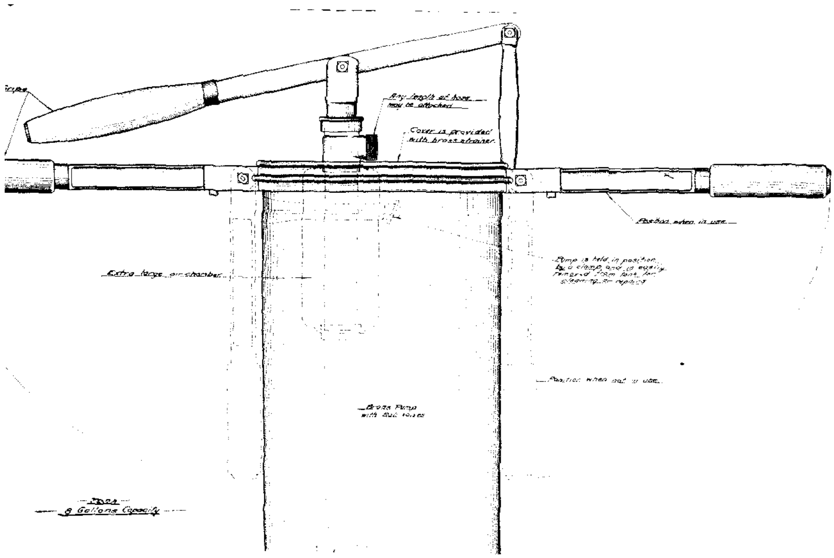
* City Fire Chief in charge of whatever forest protection is necessary.

TOWN FIRE WARDENS 1911—*Continued.*

Town	Name of Warden	Address
Griswold	Irving O. Burdick	Norwich, R. F. D. No. 5
Groton	Daniel Chesebro	Mystic, R. F. D. No. 1
Guilford	Burton W. Bishop	Guilford, R. F. D. No. 2
Haddam	Ephraim P. Arnold	Haddam
Hamden	Samuel A. Flight	Highwood
Hampton	William S. Ford	Hampton
*Hartford		
Hartland	Edw. E. Emmons	East Hartland
Harwinton	James P. Hogan	Torrington, R. F. D. No. 2
Hebron	T. R. Prentice	Turnerville
Huntington	H. L. Bowles	Shelton
Kent	John H. Finn	Kent
Killingly	Sidney Bastow	East Killingly
Killingworth	H. R. Blatchley	Clinton, R. F. D. No. 2
Lebanon	M. M. Hazen	Leonard Bridge
Ledyard	Frederick W. Burton	Mystic, R. F. D.
Lisbon	Frank E. Hyde	Norwich, R. F. D. No. 4
Litchfield	Geo. H. Hunt	Litchfield, R. F. D. No. 4
Lyme	James E. Beebe	Hamburgh
Madison	Walter E. Clark	Madison
Manchester	John S. Risley	So. Manchester, R. F. D. No. 2
Mansfield	James C. Green	Eagleville, R. F. D. No. 2
Marlborough	Byron S. Lord	East Hampton, R. F. D. No. 2
Meriden	William C. Lucas	Meriden
Middlebury	D. L. Wheeler	Waterbury, R. F. D. No. 3
Middlefield	Luther W. Fowler	Middlefield
Middletown	†P. J. Kennedy	Middletown
Milford	George J. Smith	Milford
Monroe	Myron S. Clark	Stepney Depot, R. F. D. No. 14
Montville	John J. Driscoll	Montville
Morris	Clark H. Emmons	West Morris
Naugatuck	Wilson F. Clark	Naugatuck
*New Britain		
New Canaan	George T. Smith	New Canaan
New Fairfield	Edward Jennings	New Fairfield, R. F. D. No. 54
New Hartford	Riley M. Olmsted	New Hartford, R. F. D. No. 2
*New Haven		
Newington	Robert Dart	Newington
*New London		
New Milford	Walter L. Erwin	New Milford
Newtown	Frederick B. Lake	Hawleyville
Norfolk	Thomas P. Higgins	Norfolk
North Branford	Edmund M. Field	Northford, R. F. D. No. 1
North Canaan	Charles H. Sage	East Canaan
North Haven	Lawrence Bruce	North Haven
North Stonington	Jas. Frank Brown, Jr.	North Stonington, R. F. D.
Norwalk	George W. Mills	Norwalk, Broad River, R. F. D.
Norwich	C. P. Bushnell	Norwich, R. F. D. No. 4
Old Lyme	George Griswold	Lyme
Old Saybrook	James U. Dibble	Old Saybrook
Orange	Charles S. Clark	Orange
Oxford	F. W. Hubbell	Seymour, R. F. D.
Plainfield	A. B. Mathewson	Plainfield
Plainville	Wm. J. Simpson	Plainville

TOWN FIRE WARDENS 1911—*Continued.*

Town	Name of Warden	Address
Pomfret	Seymour Peal	Abington
Portland	Joseph P. Synnott	Portland, R. F. D.
Preston	E. P. Barnes	Norwich, R. F. D. No. 3
Prospect	Chas. S. Fenn	Prospect, R. F. D. No. 2
Putnam	B. K. Smith	Putnam
Redding	Daniel R. Warner	Bethel, R. F. D. No. 24
Ridgefield	George H. Beeker	Ridgefield
Rocky Hill	Ira E. Holmes	Rocky Hill
Roxbury	Henry L. Smith	Roxbury
Salem	Charles I. Beebe	Colchester, R. F. D. No. 3
Salisbury	John S. Perkins	Lakeville
Saybrook	James A. Jones	Deep River
Scotland	Frank E. Allen	Baltic, R. F. D.
Seymour	Walter B. Johnson	Seymour
Sharon	Louis Miller	Sharon
Sherman	David D. Gray	Sherman
Simsbury	James M. Stocking	Weatogue
Somers	John Hunt	Somers
Southbury	Elmer A. Lewis	Southbury, R. F. D.
Southington	C. F. Hamlin	Plantsville
South Windsor	John C. Stoughton	Wapping
Sprague	Arthur Dobbron	Baltic
Stafford	John M. Larned	Stafford Springs
Stamford	F. V. Stevens, Jr.	Stamford
Sterling	Henry R. Brown	Sterling
Stonington	E. Everett Watrous	Westerly, R. I., R. F. D.
Stratford	W. J. Williamson	Stratford
Suffield	Ernest N. Austin	Suffield
Thomaston	William Johnston	Thomaston
Thompson	Thomas Ryan	Thompson
Tolland	Oscar Leonard	Rockville
Torrington	F. H. Baldwin	Torrington
Trumbull	Burr F. Beach	Trumbull
Union	Eugene Walker	Southbridge, Mass., R.F.D. No. 2
Vernon	Chas. W. Bradley	Rockville
Voluntown	Walter C. Tanner	Voluntown
Wallingford	William B. Ives	Wallingford, R. F. D. No. 3
Warren	Henry S. Morrow	New Preston
Washington	John A. Winterburn	West Morris
*Waterbury		
Waterford	Park B. Smith	Waterford
Watertown	Simeon M. Jones	Watertown, R. F. D. No. 2
Westbrook	Lewis N. Stevens	Westbrook
West Hartford	W. E. Johnson	West Hartford
Weston	Chas. E. Lockwood	Georgetown
Westport	Stanley B. Fillow	Westport
Wethersfield	Herbert W. Wells	Wethersfield
Willington	E. C. Eldredge	South Willington
Wilton	E. S. Jennings	Wilton
Winchester	Elliott B. Bronson	Winsted
Windham	James D. Wilson	Willimantic, R. F. D. No. 2
Windsor	M. W. Gilligan	Windsor
Windsor Locks	Willis H. Birge	Windsor Locks
Wolcott	E. M. Upson	Terryville, R. F. D.
Woodbridge	Elmer E. Little	Westville

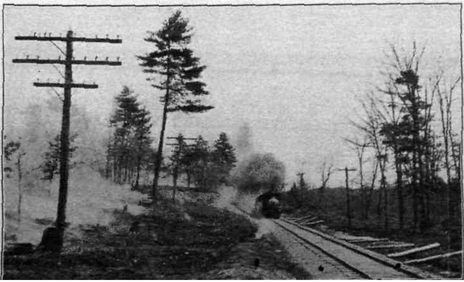

Grips
Any length of hose
may be attached
Cover is provided
with brass strainer.
Position when in use
Extra large air chamber
Pump is held in position
by a clamp and is easily
removed from tank for
cleaning or repairs
Position when not in use
Brass Pump
with Ball valves
8 Gallons Capacity

Putting out a grass fire with ordinary bucket pump specially adapted to the purpose. Town of Simsbury. p. 788.

Testing first model of two-man pump at fire on cut-over land. p. 788.

Railroad right of way through State land where fires formerly did great damage. p. 789.

Fire wardens of Simsbury and their equipment. 100 ft. strip outside of right of way being cleared by burning. p. 790.



PART XII.

GARDEN AND FIELD SEEDS SOLD IN CONNECTICUT IN 1910-11

By Mary H. Jagger and E. H. Jenkins *

During the time covered by this report 1034 examinations of seeds have been made, in the interest of the seed growers and farmers of this state.

No farmer can afford to lay down land with any grain or with clover or grass seed without assuring himself in some way that his seed will germinate under proper conditions, that it is true to name and that it is fairly clean and free from noxious weeds. This assurance he may often get by personal inspection of the seed and by a germinating test made at home.

A pinch or two of a grass or clover seed, or a hundred kernels of oats, wheat or rye, spread carefully on a thick damp woolen cloth over which another is laid, rolled together and kept in a damp warm place a week, will show fairly well whether the tested seed will "come" or not in the field.

The "look" of the seed is often very deceptive. For example; quite a number of complete or partial failures of oats have come to our attention. The seed was bright and clean but it had been ruined by bleaching with burning sulphur fumes. Some samples were entirely killed, of others not more than 20 per cent. were alive.

An hour's time given to a test of sprouting the oats before sowing would have avoided the loss of the crop.

To determine certainly the genuineness of clover, alfalfa and some grasses is not easy for most farmers.

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* All the tests of seeds reported in this paper and the identification of foreign seeds has been the work of Miss Jagger. The Director has assisted in preparing the work for publication.

This Station therefore undertakes, to the extent of its ability, to test seeds with reference to their purity and vitality, both for farmers and also for growers and dealers within the state, to the end that farm production may not be handicapped at the very start by inferior seed.

All such work, done at the state expense, can only be justified when it is of general interest and importance.

A state institution cannot fairly do work which has interest or value to a single individual alone.

Therefore every sample sent should have with it the facts which are of general importance; for example, the name and address of the party who sells it, the price, the name under which it is sold, whether it is claimed to be fresh and of good quality, etc. A blank form is supplied by the Station for these particulars giving also directions for sampling which should be carefully followed.

The Station spends the time of an expert and provides laboratory facilities for the work of carefully examining the sample, seed by seed.

This is time thrown away if the sample does not fairly represent the stock from which it was taken.

To fairly sample seeds is not in many cases an easy matter.

To give it value to the sender and to the public alike,

1. The sample should represent stock offered for sale in the state. A small sample sent by mail from some dealer at a distance is of no value unless he guarantees that the goods shipped shall be like the sample, in which case a sample of the goods as delivered should be sent, for comparison.

2. The sample should be described on a blank which will be supplied by the Station on request.

3. The sample should be so taken as to fairly represent the stock on hand. Carelessness or inaccuracy in this particular impairs or destroys the value of the Station's work.

Instructions for Sampling Seeds.

An accurate sample can be taken by following these directions.

1. Mix well together with the hand and arm the contents of the package (bag or barrel) of seed.

Red Clover.

The quality of the seed bought by our agent was in general good, the average purity being 95.7 per cent. and the "viability," —that is the percentage of pure seed which germinated,—88.7.

Four samples, 6110, 6112, 6117 and 6545, contain more inert matter and foreign seeds than are desirable. The larger part of the foreign seeds are long-leaved and Rugel's plantain, dock and foxtail or bottle grass. The first three are pestilent weeds.

Either field dodder or European dodder was found in samples 6095, 6108, 6112, 6117, 6122, 6148, 6028, and 6545, that is in one-quarter of the number tested. It was very abundant in 6095, 6108 and 6122.

The inert matter in 6090 and 6136 is chiefly worthless clover seeds which crumble easily. Some such seeds are also found in several other samples, being seeds ruined by the clover-seed chalcid. Dr. Britton (see page 709 of this report) states that this insect is distribnted nearly all over the United States and in some localities is a serious pest. The insect lays its eggs in the clover heads in the field and the adult four-winged flies emerge from the mature seeds. Seed thus attacked of course is of no value as the embryo is entirely eaten out by the insect.

In all, about 45 species of weed seeds were found in the bought samples of red clover. The most important have been named above.

Mammoth Red Clover.

Sample 6089 contained about 5 per cent. of common sorrel.

White Clover.

The viability of this clover was considerably lower than that of red or alsike clover. More than half of the foreign seeds in 6132 were harmless, timothy and red clover; the weeds being sorrel, pepper grass, pigweed and catchfly. 6140 contains dodder, 596 seeds to the pound, and 6147 contains less than this. 6140 has over 50,000 weed seeds in the pound, most of them sorrel. In all, about 25 species of weed seeds were found in these samples.

Alsike Clover.

The samples examined were of about average quality, 6131 containing some dodder, about 125 seeds to the pound.

The foreign seed consisted chiefly of timothy and clovers. About sixteen species of weed seeds were found.

Alfalfa.

No dodder was found in any of the six samples bought by the Station and the percentage of foreign seed is very small. 6118 has a very low germination.

The average viability of the others is 84.4 per cent. which is about what standard alfalfa should have.

In the case of leguminous seeds, such as clovers and alfalfa, one third of the seeds remaining hard at the end of the germination test are counted as viable. That is, if the seed were planted it is assumed that at least one third of these hard seeds would sprout during the season.

In alfalfa seed number 6515 there was about fifty per cent. of these hard seeds at the end of the sprouting test. Such a large amount might seriously affect the character of the crop.

Of the samples reported in the table drawn by others than the Station agent, 6087 and 6159 contained dodder seed.

Alfalfa seed should have a bright yellow color. Brown seed should be avoided as the color is a sign of inferiority.

Timothy.

The eight samples of timothy examined were very pure, one of them showing 100 per cent. and none of them less than 97.4 per cent. purity.

Two of them, however, did not sprout satisfactorily.

Of the samples sent by others than the Station agent, 6013 had very low germinating power and was somewhat dirty. A part of the seed was brown and hard as if it had been heated. Such seed was entirely dead.

Red-Top.

The inert matter in red-top should consist chiefly of portions of the flower which cannot be perfectly separated

but the exceptionally large amount of foreign matter in 6123 i due to 11.1 per cent. of sand; 6113 contained much dirt, chaf and sticks.

Yarrow, and cinquefoil, *Potentilla*, are the most abundan weeds and seven of the samples also contained over 9 per cent. o: timothy.

Of the samples sent in for examination 5964 had 11.6 per cent of inert matter, 5.6 per cent. of timothy, also seeds of yarrow, pep per grass and plantain. 6015 was dirty but had few weed seeds Number 6029 had 9.3 per cent. of timothy with some yarrow anc seeds of rush, *Juncus* sp. 6508 contained over 13 per cent. o: timothy.

TABLE I.—ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1

Station No.	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.
	RED CLOVER SEED.					
	Purchased by Station Agent.					
6095	W. A. Burr, West Hartford	1.56	96.4	1.5	2.1	97.0
6100	Blish Hdw. Co., So. Manchester	1.69	98.8	1.0	0.2	97.0
6102	Wheeler & Co., Bridgeport	1.62	98.8	0.7	0.5	94.5
6104	Church & Morse, Meriden	1.65	99.0	0.5	0.5	93.0
6108	Olds & Whipple, Hartford	1.54	94.8	2.6	2.6	95.0
6110	T. H. Eldridge, Norwich	1.61	88.3	4.4	7.3	90.0
6112	F. C. Benjamin & Co., Danbury	1.53	88.3	5.0	6.7	90.0
6117	G. M. Williams Co., New London	1.45	88.1	5.5	6.4	88.0
6119	F. S. Bidwell & Co., Windsor Locks	1.58	99.6	0.2	0.2	95.0
6122	F. A. Hull & Son, Danbury	1.53	97.2	1.8	1.0	94.5
6128	E. A. Buck & Co., Willimantic	1.36	97.6	1.7	0.7	93.5
6133	Farmers' Supply Co., Bridgeport	1.65	91.5	5.4	3.1	96.5
6136	Greenwich Hdw. Co., Greenwich	1.70	92.8	4.2	3.0	94.0
6137	P. Swartz, New London	1.54	94.8	2.1	3.1	90.5
6142	Cadwell & Jones, Hartford	1.74	97.8	1.2	1.0	94.0
6148	Spencer Bro., Suffield	1.61	99.1	0.5	0.4	95.5
6150	F. S. Platt Co., New Haven	1.55	94.4	2.7	2.9	87.0
	* *Sent by interested persons.*					
5589	Wilcox & Co., Simsbury	1.64	99.5	0.5*	--	90.5
5612	D. L. Dickinson & Son, Waterbury	1.69	99.2	0.8*	--	95.5
5959	E. W. Conklin & Son, New York	1.70	98.8	1.2*	--	93.0
5989	F. S. Platt Co., New Haven	1.68	97.1	2.9*	--	81.0
6012	Wm. Segar & Co., Westerly, R. I.	1.67	97.7	2.3*	--	88.0
6028	W. E. Barrett & Co. Providence, R. I.	1.62	98.8	1.2*	--	92.0
6090	Bash & Co., Fort Wayne, Ind.	1.58	93.6	6.4*	--	83.5
6155	Wheeler & Co., Bridgeport	1.62	94.4	5.6*	--	93.5
6156	" " "	1.73	97.1	2.9*	--	93.0
6439	Cadwell & Jones, Hartford	1.47	99.0	1.0*	--	93.5
6501		1.58	98.2	1.8*	--	94.0
6512		1.55	97.5	2.5*	--	97.0
6545	Brower & Malone, Norwalk	1.83	91.6	3.6	4.8	91.0

BLE I.—ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1910—*Continue*

n	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.	Viability per cent
	MAMMOTH RED CLOVER. *Sent by interested persons.*						
0	E. W. Conklin & Son, New York	1.63	98.4	1.6*	..	94.5	92.
0	F. S. Platt Co., New Haven	1.67	97.8	2.2*	..	94.0	91.
39	Bash & Co., Fort Wayne, Ind.	1.73	94.2	5.8*	..	76.0	71.
	WHITE CLOVER. *Purchased by Station Agent.*						
32	E. A. Buck & Co., Willimantic	.63	82.7	2.9	14.4	82.0	67.
40	Hotchkiss & Templeton, Waterbury	.60	89.4	2.1	8.5	69.5	62.
47	Frank H. Smith, Middletown	.67	95.2	1.0	3.8	67.0	82.
49	Spencer Bros., Suffield	.54	96.8	1.0	2.2	79.5	76.
	Sent by interested person.						
91	Bash & Co., Fort Wayne, Ind.	.56	90.3	9.7*	..	77.0	69.
	ALSIKE CLOVER. *Purchased by Station Agent.*						
31	E. A. Buck & Co., Willimantic	.70	94.2	2.1	3.7	84.0	79
43	Cadwell & Jones, Hartford	.70	99.1	0.4	0.5	91.0	90
45	Meriden Grain & Feed Co., Meriden	.73	94.3	0.5	5.2	88.0	82
46	Frank H. Smith, Middletown	.64	93.4	1.1	5.5	86.5	80
151	F. S. Platt Co., New Haven	.56	92.4	0.7	6.9	80.0	73
	ALFALFA. *Purchased by Station Agent.*						
098	Blish Hdw. Co., So. Manchester	2.03	97.3	2.1	0.6	92.0	8
118	G. M. Williams Co., New London	2.07	96.9	1.9	1.2	38.5	3
120	F. S. Bidwell & Co., Windsor Locks	2.03	99.3	0.3	0.3	90.5	8
126	J. P. Barstow & Co., Norwich	1.87	96.9	1.4	1.7	83.5	8
129	E. A. Buck & Co., Willimantic	2.08	97.4	1.7	.9	83.5	8
144	Meriden Grain & Feed Co., Meriden	1.92	97.0	1.7	1.3	83.0	8
	Sent by interested persons.						
596	E. W. Conklin & Son, New York	2.18	98.5	1.5*	--	88.5	8
087	Whitney Noyes & Co., Buffalo, N. Y.	1.86	98.9	1.1*	--	93.5	[illegible]
154	Wing Seed Co., Mechanicsburg, O.	2.00	99.0	1.0*	--	91.5	[illegible]
159	F. S. Platt Co., New Haven	2.14	97.0	3.0*	--	86.0	[illegible]
164	Wheeler & Co., Bridgeport	2.05	93.1	6.9*	--	74.5	[illegible]
165	F. S. Platt Co., New Haven	2.02	96.8	3.2*	--	71.0	[illegible]
515	A. B. Lyman, Minn.	2.07	98.8	1.2*	--	64.0	[illegible]
	TIMOTHY. *Purchased by Station Agent.*						
6099	Blish Hdw. Co., So. Manchester	.417	99.4	0.3	0.3	95.5	
6101	Wheeler & Co., Bridgeport	.382	99.8	0.1	0.1	91.0	
6106	Olds & Whipple, Hartford	.410	99.7	0.1	0.1	97.3	
6109	T. H. Eldridge, Norwich	.390	98.8	0.6	0.6	68.3	
6116	Lyon & Ewald, New London	.395	98.0	0.7			
6121	F. S. Bidwell & Co., Windsor Locks	.420	100.0	---			
6125	J. P. Barstow & Co., Norwich	.350	99.7	0.2			
6130	E. A. Buck & Co., Willimantic	.380	97.4	0.9			

[TAB]LE I.—ALFALFA, GRASS AND CLOVER SEEDS EXAMINED IN 1910—*Conclud[ed]*

[Statio]n	Dealer	1000 seeds weigh, grams.	Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Pure seed germination, per cent.	Viabil[ity] per ce[nt].
	TIMOTHY—*Concluded.*						
	Sent by interested persons.						
6	D. L. Dickinson & Son, Waterbury	.41	99.9	0.1*	--	90.8	90
0	Wilcox & Co., Simsbury	.40	99.5	0.5*	--	89.0	88
1	E. W. Conklin & Son, New York	.39	99.3	0.7*	--	89.0	88
2	" " " "	.33	97.7	2.3*	--	84.0	82
3	" " " "	.36	98.6	1.4*	--	95.8	94
4	" " " "	.41	99.5	0.5*	--	98.5	98
3	Wm. Segar & Co., Westerly, R. I.	.36	96.3	3.7*	--	56.8	54
0	W. E. Barrett & Co., Providence, R. I.	.34	97.2	2.8*	--	96.0	93
5	E. W. Conklin & Son, Bingh'mt'n, N. Y.	.41	99.8	.2*	--	70.8	70
7	" " " " "	.35	98.5	1.5*	--	86.3	85
5	Brower & Malone, Norwalk	.40	99.6	.4*	--	91.8	91
5	------------	.43	98.2	1.8*	--	87.5	85
	RED-TOP.						
	Purchased by Station Agent.						
5	W. A. Burr, West Hartford	.087	76.7	7.1	16.2	73.8	56
7	Blish Hdw. Co., So. Manchester	.085	93.7	5.5	0.8	72.0	6[illegible]
3	Wheeler & Co., Bridgeport	.090	94.6	4.7	0.7	88.8	8[illegible]
5	Church & Morse, Meriden	.085	78.0	9.1	12.9	72.3	5[illegible]
7	Olds & Whipple, Hartford	.097	69.0	6.7	24.3	84.0	5[illegible]
1	T. H. Eldridge, Norwich	.085	74.8	8.0	17.2	67.0	5[illegible]
3	F. C. Benjamin & Co., Danbury	.090	67.0	17.6	15.4	70.8	4[illegible]
4	I. W. Dennison, Mystic	.097	90.0	9.6	0.4	78.8	7[illegible]
3	F. A. Hull & Son, Danbury	.090	81.2	15.1	3.7	74.8	6[illegible]
[illegible]	*J. P. Barstow & Co., Norwich*	.092	89.6	8.3	2.1	84.8	7[illegible]
7	E. A. Buck & Co., Willimantic	.100	90.0	6.3	3.7	69.5	6[illegible]
[illegible]	Farmer's Supply Co., Bridgeport	.085	74.2	8.3	17.5	64.8	4[illegible]
5	Greenwich Hdw. Co., Greenwich	.090	93.7	5.5	0.8	72.8	6[illegible]
[illegible]	Hotchkiss & Templeton, Waterbury	.090	72.7	12.5	14.8	61.0	4[illegible]
	Sent by interested persons.						
3	E. W. Conklin & Son, New York	.09	91.4	8.6*	---	92.8	8[illegible]
[illegible]	" " " "	.08	78.8	21.2*	---	91.8	7[illegible]
2	" " " "	.08	93.2	6.8*	---	91.0	8[illegible]
[illegible]	Wm. Segar, Westerly, R. I.	.08	85.9	14.1*	---	86.8	7[illegible]
[illegible]	*W. E. Barrett & Co., Providence, R. I.*	*.08*	*84.4*	*15.6**	---	*89.8*	7[illegible]
[illegible]	Bash & Co., Fort Wayne, Ind.	.08	91.2	8.8*	---	92.0	84
[illegible]	C. D. Bushnen, Plantsville	.08	76.4	8.6	15.0	90.8	6[illegible]

* Includes foreign seeds.

Besides the samples tabulated a considerable number of very small samples were sent by prospective buyers with inquiry as to their quality. These samples were too small to justify a full examination or, in our judgment to fairly represent any lot of seed.

TESTS OF GRASS, CLOVER AND ALFALFA SEED.

	No. Tested	Clean Seed	Contained Weeds	Contained Dodder	Contained Dodder and Weeds	Contained much Dirt
Red Clover	30	13	3	..	12	2
Mammoth Clover ..	4	1	1	1	1	..
White Clover	4	3	1	..	..	..
Alsike Clover	8	6	2	..	..	..
Alfalfa	24	13	7	4	..	..
Timothy	23	12	11	..	..	..
Red Top	14	7	5	..	..	2
Total No. tested	107	55				

One of the samples of red clover classed as containing dodder and weeds was probably adulterated with alfalfa screenings. About twenty per cent. of this sample consisted of broken or light, shriveled seeds of red clover and alfalfa. Dodder and weed seeds were abundant, there being about four thousand dodder seeds to the pound.

The sample of mammoth clover classed as weedy contained, besides other weeds, about one per cent. of black medic, a worthless plant.

TESTS OF THE VITALITY OF VEGETABLE SEEDS SENT BY GROWERS, DEALERS OR PURCHASERS, 1909 and 1910.

Within the period above named seven hundred and ninety-six samples of field and garden seeds have been tested as to their sprouting capacity. A brief summary only of the results can here be given.

Comparison of the Vitality of Crops of Connecticut-Grown Onion Seed Less than One Year Old in the Years 1894-1910.

TABLE I.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples tested	Average Percentage sprouted
In 1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9

	No. of Samples tested	Average Percentage sprouted
In 1900	77	88.5
1901	60	71.0
1902	60	80.6
1903	59	62.0
1904	42	80.4
1905	37	78.6
1906	62	77.2
1907	24	88.8
1908	119	74.5
1909	89	72.5
1910	57	64.3

Average for 17 consecutive years, 75.1 per cent.

The exceptionally low vitality of the 1910 seed is due to the blasting of the crop in the field.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of five varieties, of which a considerable number of samples have been tested, is as follows (only those samples are here included which were stated to be less than one year old at the time of testing and were grown in Connecticut):

TABLE II.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

	No. of Samples tested	Average Percentage of Sprouting Seed
Yellow Globe	397	73.97
Red Globe	283	77.73
White Globe	201	77.69
White Portugal	34	70.82
Wethersfield Red	15	79.07

Vitality of Onion Seed as Affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 1756 samples of onion seed of the crop of 1896 and of each succeeding crop. The results are summarized in the following table:

TABLE III.—VITALITY OF ONION SEED.

	Connecticut Grown		Cal. Grown	
	No. of Samples	Per cent. sprouted	No. of Samples	Per cent. sprouted
Seed stated to be less than one year old	861	74.72	400	88.18
Seed stated to be between one and two years old...	165	65.58	220	77.46
Seed stated to be between two and three years old	24	21.90	2023	57.34
Seed stated to be between three and four years old	1	59.50	1	10.00

It is quite clear that as a rule a larger percentage of California-grown onion seed germinates than of Connecticut-grown seed. It is also quite clear that, as a rule, onion seed one year old has a much lower sprouting capacity than new seed, though there are many exceptions to this. Seed from a good crop when one year old will sometimes germinate quite as well as new seed from an inferior crop.

Vitality of Sweet Corn Seed.

The following table gives the average, maximum and minimum vitality found in tests of Connecticut-grown sweet corn less than one year during the years 1904 to 1910:

	No. of Samples tested	Average Percentage by number of Seed sprouting	Maximum	Minimum
Country Gentleman	19	87.9	100.0	59.0
Early Crosby less than one year old	12	93.5	100.0	77.0
Early Crosby one to two years old	4	63.6	85.0	42.0
Early Evergreen less than one year old	3	87.8	96.0	82.0
Early Evergreen one to two years old	1	91.0	....	....
"Evergreen" less than one year old	12	88.0	....	....
"Evergreen" one to two years old	3	80.7	92.0	73.0
Acme Evergreen one to two years old	1	80.0	....	....
Hickox	4	83.2	96.0	65.0
Metropolitan	4	91.7	99.0	85.0
Old Colony less than one year old	5	84.6	100.0	57.0
Old Colony one to two years old	1	80.0	....	....
Old Colony two to three years old	1	45.0	....	....
Stowell's Evergreen less than one year old	25	86.1	100.0	48.0
Stowell's Evergreen one to two years old	8	81.7	99.0	62.5
Early Dawn	1	96.0	....	....
Ne Plus Ultra	1	72.5	....	....

In our opinion the showing of sweet corn is a poor one as regards vitality, and greater care in curing and better arrangements in the barns where the seed is dried after harvesting would considerably improve the quality of the seed.

Soil and climate give this state an exceptional chance to be the center of the sweet corn seed production. It is about the northern limit for the safe maturing of most varieties of sweet corn seed and the quality of these varieties here is generally believed to be better than when grown in a warmer climate.

The matter of proper curing has been briefly discussed in our Report for 1907-1908, p. 401.

Note on the Moulding of Seed during the Germinating Test.

Fungi of various sorts frequently grow on and about seeds set to germinate on sterilized cloth or paper in a sterilized chamber. Their spores or mycelia are therefore quite certainly on or in the seed itself. If they are within the tissues of the seed they cannot be killed by external treatment and will probably injure the plant sooner or later. If they are outside the living tissues the question arises whether conditions in the germinator favor their growth more than conditions in the soil. If so they may attack and destroy the germ before it developes and thus the germinator test may give results much lower than a field test rather than higher.

It is often assumed that a larger percentage of seed will sprout in a laboratory test than in the field, because conditions are under control and accidents less likely to occur in the laboratory. We may say in passing that considerable experience in the work makes us very skeptical of the truth of this assumption.

The following experiment was made to see whether in a special case sterilizing the exterior of the seed would increase the percentage germination. The results may be of some general interest.

Five samples of pepper seeds of the 1910 crop which had low germinating power and moulded badly during the test, were afterwards sprouted under the following conditions, in the standard S[illegible] rminator made by The Kny-Scheerer Company of New York tw[illegible] is germinator was thoroughly cleaned and disinfected with Seed [illegible] three [illegible] All water used in the tests was sterilized and also th

blotters in which the seeds were placed. Ten lots of 100 seeds from each of the five samples were treated as follows:

Two lots were soaked for 10 minutes each in ¼, ½, 2 and 8 per cent. formalin solution. They were then rinsed twice with sterilized water and placed on sterile blotters in the germinator, where they remained fourteen days, counts being made five times during this period. The water tests were made as checks, the seeds not being soaked but put directly into the germinator.

The results are summarized as follows,—each figure being an average of two tests. The greatest difference between duplicates being 7 and the average difference 2.8 per cent:—

Germination Tests of Pepper Seeds.

Station No.	Water	Formaldehyde Solution ¼ per cent.	½ per cent.	2 per cent.	Average germination in ¼, ½ and 2 per cent.	8 per cent.
Per cent. sprouted in 14 days.						
6440	68.0	69.0	73.5	69.5	70.6	33.5
6441	21.5	20.0	12.5	23.5	18.6	11.5
6442	55.0	56.0	57.5	56.0	56.5	56.5
6443	24.0	18.0	16.5	21.0	18.5	12.0
6444	50.5	37.0	56.0	53.0	48.6	44.0
Average..	43.8	40.0	43.2	44.6	....	31.5
*Per cent. moulded in 14 days.**						
6440	31.0	25.5	20.0	10.0	....	3.5
6441	78.0	76.5	63.0	73.5	....	37.5
6442	42.5	28.0	28.5	14.5	....	8.0
6443	75.0	80.5	82.0	58.0	....	65.5
6444	44.0	55.0	33.0	13.0	....	19.5
Average..	54.0	53.1	45.3	33.8	....	26.8
Per cent. remaining hard at end of 14 days.†						
6440	1.0	5.5	6.5	20.5	....	63.5
6441	0.5	3.5	24.5	3.0	....	51.0
6442	2.5	16.0	14.0	29.5	....	35.5
6443	1.0	1.5	1.5	21.0	....	22.5
6444	5.5	8.0	11.0	34.0	....	36.5
Average..	2.1	6.9	11.5	21.6	....	41.8

* By mouldy seeds are meant seeds in which the embryo itself had moulded.

† By hard seeds are meant seeds which had perfect embryos at the end

These results suggest that 6441 and 6443 were much more seriously infected with moulds than the others, as shown by the much larger percentage that moulded during the test.

These two also showed practically no increase in germination following formalin treatment and relatively little decrease in mould.

In one case eight per cent. formalin did not damage the germinating power, but in four cases it did cause injury.

The limit for the safe use of it in these cases must be considerably less than eight per cent. when treated ten minutes.

Excluding from consideration 6441 and 6443 as being so deeply infected with microbe life that their germination under uniform external conditions must be very irregular, a ten minute treatment of the seed with ½ and with 2 per cent. formalin seems to have only very slightly improved germination although it reduced considerably the number of mouldy seed.

We give these figures not as in any way conclusive. It satisfied us, however, that if germination was depressed by the growth of moulds in these cases, a treatment with formalin did not kill such moulds.

The genera of fungi developed on the seed which were identified by Mr. Stoddard were, Alternaria, Penicillium, Fusarium, Rhizopus, Aspergillus, three unidentified, besides bacteria and yeasts. Treatment with formalin did not change the nature of the flora. Most of these were apparently saprophytic moulds whose spores merely adhered to the seeds.

We conclude that in these cases the microbe life which could be destroyed with formalin treatment did not seriously affect

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